DOCUMENT RESUME

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ABSTRACT

Developed by elementary teachers in the Jackson (Michigan) public schools as part of an inservice workshop in sex equity, this career education program in science for elementary students is intended to encourage young women to consider careers in science that are nontraditional for women. The program is divided into six grade levels; each grade unit includes five daily 1-hour sessions. Each grade unit contains a pre- and posttest, at least one scientific experiment, a class project, and activity sheets for students to supplement their learning. An overview of each grade unit is provided to give a "flavor" of the daily session outlines that follow. All necessary supplemental materials are included in each grade unit. In addition, reading material for the teachers are included on the topic of women in particular science fields, and audiovisual materials are suggested. Since the units focus on women in science, at least one activity in each grade level unit stresses this purpose. In some cases, a female resource speaker may be invited to talk to the class. In other classes, a discussion of the role of women in science is part of the outlined format of the unit, while in other cases a field trip or hands-on experience stresses encouragement of women in nontraditional science fields. (All materials for the scientific experiments were reproduced from "Comets," an elementary science curriculum developed in 1981 at the University of Kansas.) (KC)

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A Note to the Teacher

This career education program in Science for elementary students was developed by a group of elementary teachers in the Jackson Public Schools as part of an inservice workshop in sex equity. This inservice workshop was one of several sex equity projects, activities and programs sponsored for staff in the Jackson Public Schools as part of a federal grant to assist local school districts to achieve Title IX compliance and sex equity at the local level. Ms. Genevieve Hartzler, Title IX Coordinator, has directed these sex equity activities in the Jackson Public Schools since her appointment three years ago.

The career education program in Science was developed by thirteen teachers whose names are listed on the following page. Many of these teachers had received prior training in the issue of sex equity before the development of this program. The program is a tribute to their creative ideas and hard work during a day-long session in September 1982.

Design of the Program

The career education program for elementary students is divided into grade levels and includes a unit for all grades at the elementary level. Each grade unit is divided into five, one hour sessions(days). The unit is outlined in this daily, one-hour format. All supplemental materials which are necessary to complete the unit are included in a section designated as supplementary materials for that grade unit. In addition, reading material(s) for the teachers is included on

the topic of women in particular science fields.

The purpose of the career education program in science for elementary students is to encourage young women to consider careers in science which are nontraditional for the female sex. At least one activity in each grade level unit has been included to focus on this purpose. In some cases, a female resource speaker is invited to talk to the class. In other classes a discussion of the role of women in science is part of the outlined format for the unit. In other cases a field trip or hands-on experience stresses/encouragement of women in non-traditional science fields.

Each grade unit contains a pre and post testing measure for students, at least one scientific experiment, a class project and some activity(ditto)sheets for students to supplement their learning. The design of each grade unit differs, depending upon the choice and preference of the developers. An overview of the grade unit is provided to give a "flavor" of the daily session outlines that follow.

Teachers are encouraged to use all of the unit, since the activities in the week are sequenced.

All materials for the scientific experiments was reproduced from Comets, an elementary science curriculum developed in 1981 out of the University of Kansas. Comets is sex-affirmative by design. One copy of the entire Comets curriculum has been purchased and placed in the library of each elementary building in the Jackson Public Schools. Teachers are encouraged to review Comets and use additional materials from this curriculum to supplemental the career education program which is outlined in this document. In

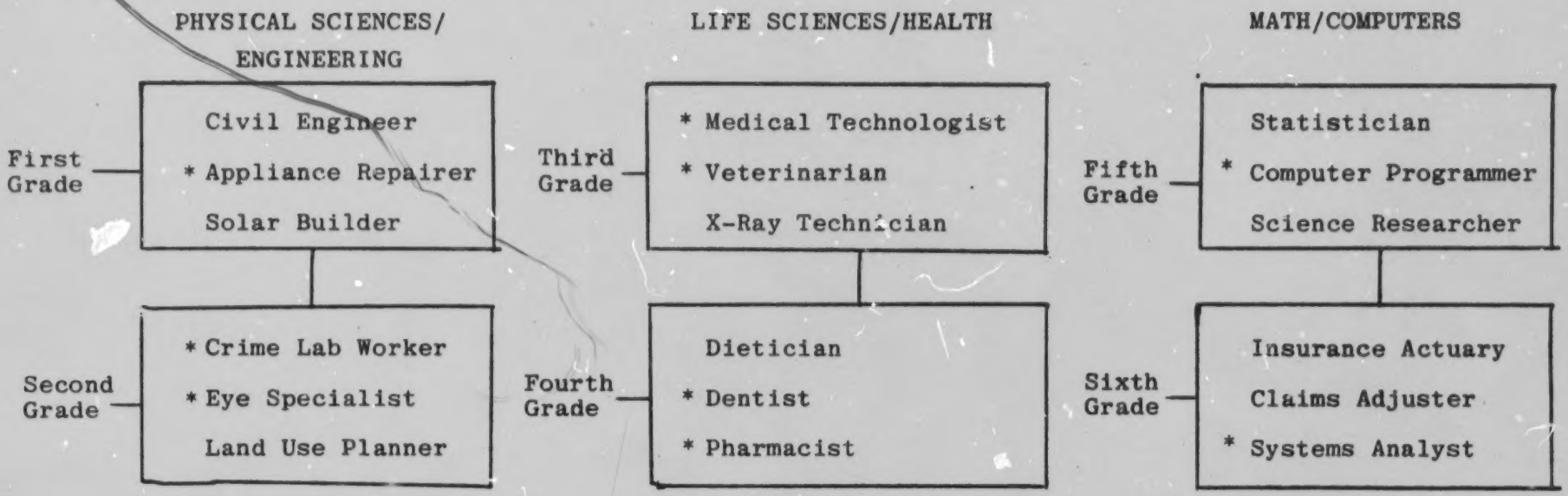
addition, a set of Comets Profiles complements the curriculum and is also available in each elementary school library. The Profiles set includes detailed vignettes of 24 women who currently are employed and well respected in specific scientific careers.

A note of caution should be sounded in reference to some of the suggested filmstrips for daily sessions. Audio visual materials were not reviewed for sex bias and sex role stereotyping prior to their being boxed and available to the developers. As a result some materials may be sex biased. Teachers are cautioned to use audio video materials only if a brief explanation is given to students that the material is outdated and does not reflect the science careers today, which have female as well as male workers in all career fields.

If you use all or part of these grade units, please take a few minutes to tell the developers and/or the Title IX Coordinator how useful they were. Suggestions for improvement of the materials are always welcome!

CAREER EDUCATION PROGRAM OUTLINE

JACKSON PUBLIC SCHOOLS



* indicates the specific career around which the grade unit has been designed. Teachers are encouraged to supplement the emphasis on the science area by referencing other careers identified in the boxes.

CAREER PROGRAM ON SCIENCE:

GRADE ONE UNIT

Emphasis: Physical Sciences

Career(s): Appliance and Computer Repairer

Developers: Ava Fobbs
Frances Reeves
Linda Robinson

GRADE ONE UNIT-OVERVIEW

This first grade unit focuses on the career of appliance repairer, with a special emphasis on repair of computers. The unit begins with a discussion of the job itself, training and salary information. A filmstrip is also suggested to be used on the first day.

Ditto sheets, emphasizing math and writing skills, are provided for the student on the second day, to follow up and reinforce the skills that an appliance/computer repairer must have. If possible, students could have a hands-on experience with a small portable computer. I female computer programmer is invited to speak to the class on the third day and demonstrate some of the simple uses of the computer.

On the fourth day the students are involved in a class project, making a collage of persons working with appliances and/or computers. Students also conduct scientific experiments making a magnet and studying principles of electricity using a lemon.

The unit is concluded with a field trip to a local or school setting where computers are located.

The pre and post test has been designed to test the students' perceptions of what they believe are appropriate jobs for men and women. Post test scores should reflect more student understanding that all jobs in appliance and computer repair are open to women as well as men.

GRADE ONE UNIT-DAY ONE

Activities

Pre Test(self explanatory)

Class Discussion of Appliance and Computer Repair Careers

Teacher Materials

Suggested filmstrip: Computer Service Technician, available from Jackson ISD media center(Career Education, SE 462)

Pre Test ditto sheets

Student Materials

None

GRADE ONE UNIT-DAY TWO

Activities

Whiz Kid Ditto Sheet

Look and Say Alphabet Ditto Sheet

Push Button Telephone Activity

Hands-On with Small Portable Computer

Teacher Materials

Ditto sheets for students

Push button telephone

Small portable computer(available from local school building)

Student Materials

Send home a note with students, explaining to the parent that the child will be exploring careers in computer and appliance repair for the remainder of the week.

GRADE ONE UNIT-DAY THREE

Activities

Invite a female computer programmer to speak to the class and demonstrate the use of the computer

Teacher Materials

Consult the Jackson Directory of Nontraditional Workers (published by the Jackson Schools Title IX Office) for the name(s) of a resource speaker who has already agreed to speak to classes in Jackson Public Schools.

Student Materials

None

GRADE ONE UNIT-DAY FOUR

Activities

Make a Collage of Pictures Showing People Working with Computers

Scientific Experiment: Making a Magnet

Scientific Experiment: Lemon Electricity

Teacher Materials

Old magazines, poster board

Experiment materials(see supplementary materials for this listing)

Student Materials

Scissors and paste

GRADE ONE UNIT-DAY FIVE

Activities

Post Test

Field Trip(suggested: Jackson Commonwealth, Jackson Media Center, or arranged visit to school library where computers are located)

Teacher Materials

Post Test ditto sheets

Student Materials

Permission slips(if necessary)

Field trip ditto sheet(follow-up)

GRADE ONE UNIT-SUPPLEMENTAL MATERIALS

The following materials are contained in this section:

Wiz Kid Activity Sheets(3)

Look and Say Alphabet Ditto Sheets

My School Field Trip Cover Sheet

Electricity/Magnetism: Student Activity

Lemon Electricity: Student Activity

Pre and Post Test

Career Information: Appliance Repairer

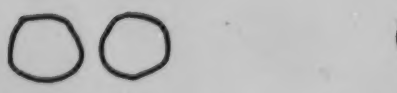
Additional Reading On Women(for teacher use)

"Women and Electricity"

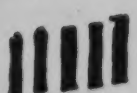
Name _____

Wiz Kid Activity

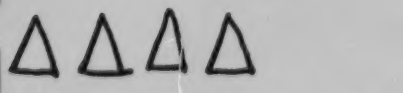
3 + 1 = _____



2 + 3 = _____



5 + 1 = _____

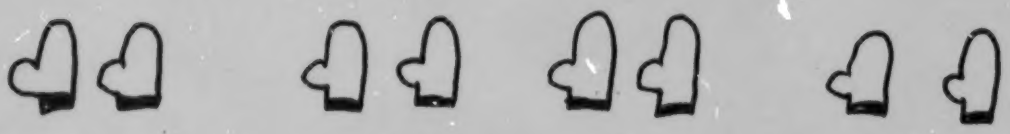


4 + 1 = _____

2 + 2 + 2 = _____

Name _____

Wiz Kid Activity



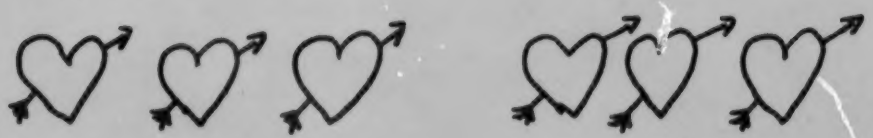
2 + 2 + 2 + 2 = ____

X X X X X

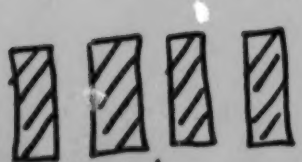
X X X X

9 − 2 = ____

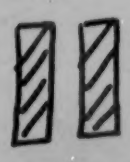
X X



3 + 3 = ____



4 − 2 = ____

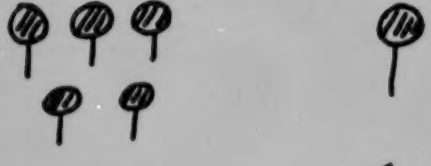


Name _____

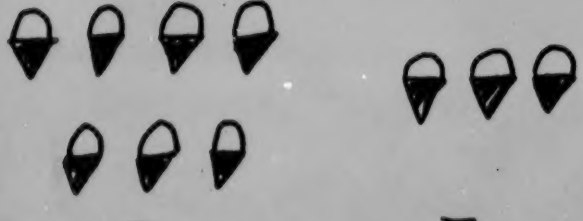
Wiz Kid Activity

3 - 1 = ____

9 - 6 = ____



5 - 1 = ____

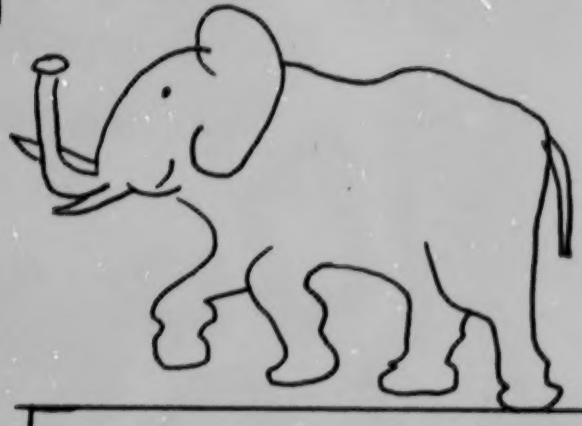


7 - 3 = ____

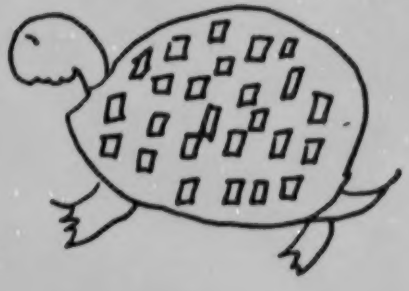
Name _____

Look and Say Alphabet

Write the beginning sound for each picture. Color.



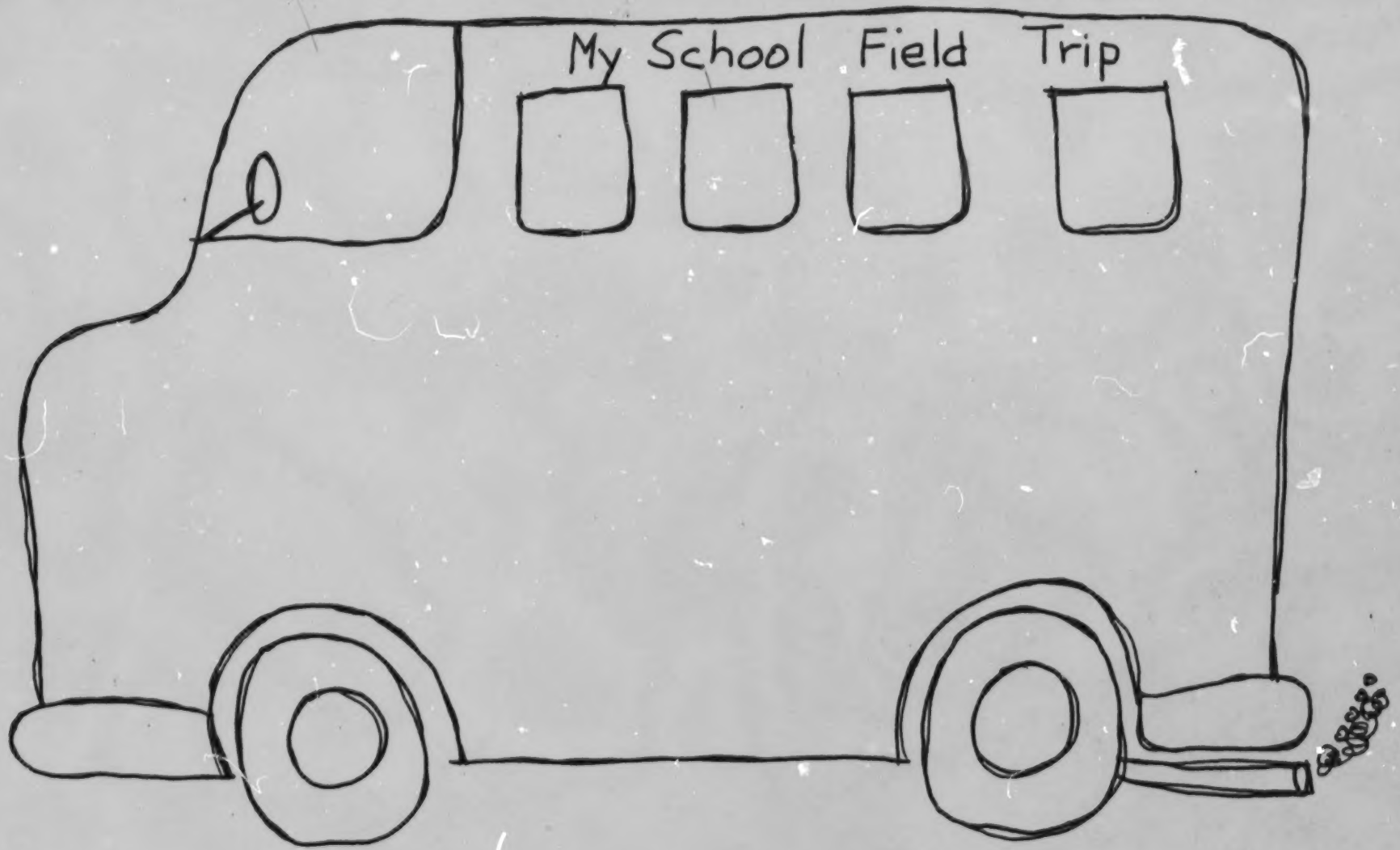
Ee _____



Ii _____

Gg _____

Oo _____


My School Field Trip

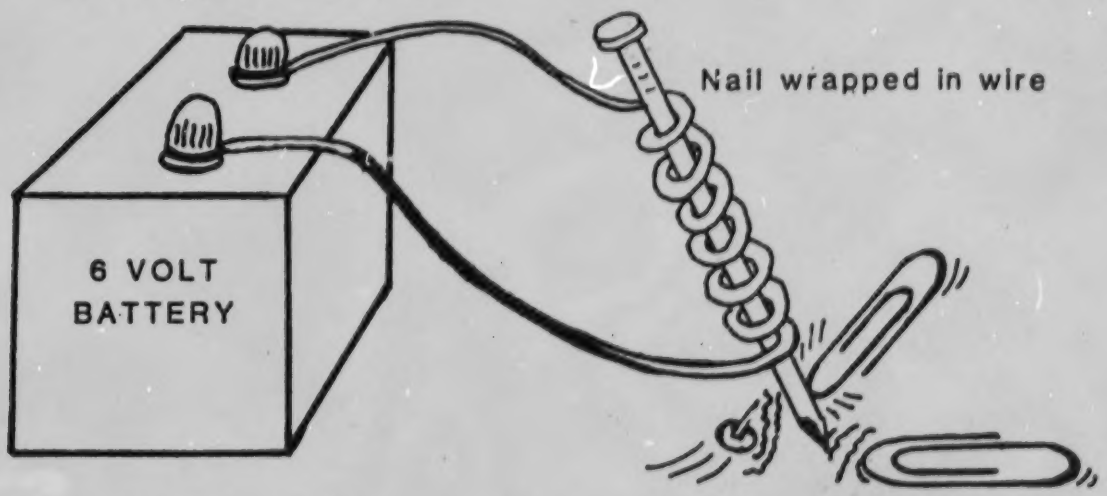
Activity II: Electricity ⇌ Magnetism

Materials:

- Nail.
- 6v battery (or other flashlight battery).
- Insulated wire.
- Tacks, paper clips, or iron filings (can be made by rubbing steel wool on a rough surface until it falls apart and collecting the pieces).

Procedure:

In Extension Activity 1 of Activity I, students made an electricity detector (i.e., a galvanometer). This same idea of using electricity to make a magnetic field is used on a larger scale to make a magnet (called an electromagnet, since it is made with electricity).



Wrap a wire several times around a nail and attach each end of the wire to a 6v battery. Touch the nail to a pile of tacks, paper clips, or iron filings. Next, have students see what happens when they do each of the following and touch their magnet to the tacks, paper clips, or iron filings.

- Double the number of turns of wire around the nail.
- Quadruple the number of turns.
- Remove the nail and insert a wooden pencil in its place.
- Vary the number of turns of wire around the pencil as was done with the nail, and compare these observations with those made with the nail.
- Remove the pencil and with just the coiled wire try to pick up the tacks, paper clips, or iron filings.

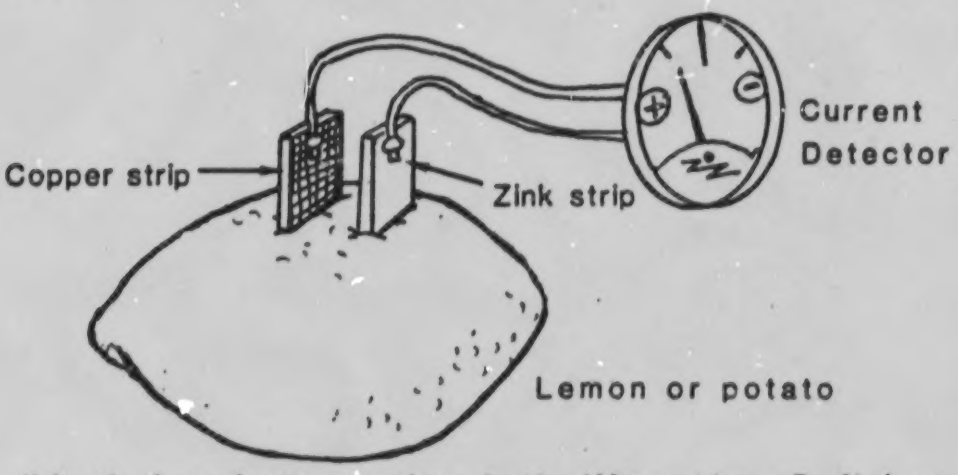
Extension Activity 2: Lemon Electricity

Materials:

- Lemon.
- Wire.
- Piece of copper metal.
- Piece of zinc metal (from high school science teacher).
- Electricity detector (galvanometer) from Extension Activity 1.

Procedure:

This is an alternative way of producing electricity by means of a chemical reaction. It can be done in addition to or instead of Activity I.



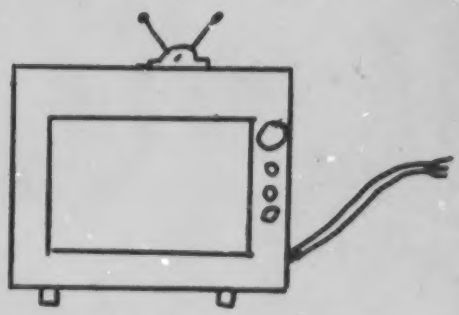
Make the lemon battery as shown in the illustration. To find out whether any electricity was made, attach the battery to an electricity detector (either a commercial galvanometer as shown here or a homemade detector like the one made in Extension Activity 1).

Pretest ☐
Posttest ☐

Who Can Do These Jobs?

woman

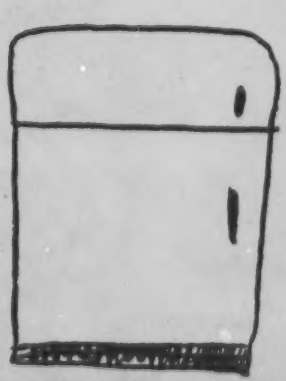
man



television

telephone

toaster



refrigerator

CAREER INFORMATION-APPLIANCE REPAIR

Job Description

Household appliance repairers install, service and repair many kinds of large and small gas and electrical appliances using hand tools. They can repair refrigerators, ovens, washing machines, hot-water heaters, toasters and irons, for example.

Household appliance repairers must locate troubles, estimate costs of repairs, keep records, test appliance parts, advise customers on the use and care of appliances, in addition to making the repairs.

Generally these persons work with little or no supervision, in repair shops, customers' homes, and places of business. They usually work 40 hours each week, and sometimes on Saturday and Sunday.

Training

There are several training methods for this career. A student can first become a helper in a repair shop and receive on the job training. Another method is to take courses in appliance repair at a vocational or technical school or through a correspondence course. Some appliance manufacturers also provide training classes for this career.

Salary

Hourly salaries range from $3.35-$10.00, depending upon experience.

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Women and Electricity

When asked, "Of what practical use is it?," one of the first scientists to work with electricity replied, "Of what practical use is a newborn baby?" That nineteenth century skeptic might also question the value of the work of Dr. Mildred Dresselhaus of Massachusetts Institute of Technology. Why cool materials to more than 450°F below zero just to see how they will behave? Why subject those materials to a magnetic force one hundred thousand times greater than the earth's own magnetic field just to see how they will act? And besides, who cares about gallium, germanium, selenium and other strange things? At one level, these questions must be answered simply, "We want to find the answers for their own sakes; we're curious." However, the doubter might be more satisfied to know that in Mildred Dresselhaus's field, solid state physics, where these feats are performed, her MIT research and the findings of others have rapidly and directly led to twentieth century electronic marvels, including the computer, calculator, hi-fi and stereo, television, radar, microwave oven, lasar, solar battery, and on and on. Words like transistor, semiconductor, integrated circuit, and chip have made their ways into our vocabulary. Virtually no part of our lives have been unaffected by the electronics revolution spawned from basic research in solid state physics. More rapidly than babies become adults, new discoveries are applied in homes, stores, doctors' offices, assembly lines, and so forth.

Of particular interest to solid state physicists like Mildred Dresselhaus is a group of materials which normally conduct electricity poorly. In their pure form, these semiconductors cannot conduct electricity; but through the strategic addition of minute amounts of impurities, these materials can conduct electricity, thus providing several advantages over conventional circuitry. Compared to conventional tubes, wires, and the like, solid state devices are smaller and lighter, so extreme miniaturization has been possible. For example, we can hold in our hand a gizmo that only a generation ago would have filled a large room and still could not have efficiently performed the complex mathematical tasks we now execute on our calculators. Solid state devices--transistors, integrated circuits, and the like--lose less energy as

B

heat, so they are energy conservative and less expensive to operate. Since they are one solid object and work at cooler temperatures, they do not break as easily as vacuum tubes and wires, so they are more dependable and last longer. Solid state devices are quite adaptable to a variety of applications; and even though the devices are extremely complex, they can be more readily manufactured than vacuum tubes and similar devices. Therefore, they are cheaper; and the products of which they are components have become rather readily available to the general population.

In Activity III students work with conventional circuits--batteries, bulbs, wires, and so forth. They can conceive of the electric current they are studying as a stream of electrons moving through the wire, roughly as water moves through a pipe. The water stream, analogous to the electric current, is composed of water drops, analogous to the electrons. Materials like copper metal have excess electrons which can move through the wire when an electric potential is added to the wire, as when the wire is attached (in a circuit) to a battery.

Similarly, some materials in transistors also allow electrons to move through them. These so-called n-type materials (n stands for negative, the charge of the electrons) are made from semiconductors by adding specific impurities which provide the excess electrons to make up the current. Interestingly, however, a second type of materials in transistors (called p-type; p stands for positive) can be made from semiconductors by the addition of some different impurities. P-type materials and the wire which your students are investigating work in opposing ways. What flows through a p-type material is not excess electrons, but rather the lack of electrons!

How can that be? Think of a row of 100 light bulbs all turned off. They could be successively turned on one at a time, thus producing the sensation that light was being passed down the row from one bulb to the next. Now think of the same 100 bulbs all turned on, except that they are successively rapidly turned off. In this instance the sensation would be that a lack of light was being passed along the row. When conceiving of transistor materials, the n-type materials are analogous to the light being passed from one bulb to the next, whereas the p-type materials are analogous to the lack of light being passed along. Transistors are made of layers of p-type and n-type materials sandwiched together in various ways to amplify current, change alternating to direct current and vice versa, and do other jobs previously done by more cumbersome and expensive vacuum tubes.

Pinpointing the precise contributions made by Dr. Mildred Dresselhaus in the development of semiconductors is difficult. Rather, what she has done is accumulate a mass of solid state physics information, especially about the characteristics of materials used in transistorr and so forth. In recognition of her work and her ability as an administrator, she has been appointed Director of M.I.T.'s Center of Material Science and Engineering. She has been honored by Hunter College, Radcliffe College, and the Society of Women Engineers; and she has held high level advisory positions with the National Science Foundation and the National Academy of Science. Furthermore, her reputation is worldwide. She has been called to visiting professorships in Israel, Brazil, Venezuela, and Japan, one of the world's primary producers of the very electronic devices to which her work has contributed.

Teacher's Notes

CAREER PROGRAM ON SCIENCE:

GRADE TWO UNIT

Emphasis: Physical Science

Career(s): Crime Lab Worker
Eye Specialist

Developers: Pearlie Brantley
Mary Bymhold

GRADE TWO UNITS-OVERIVEW

The second grade unit includes two, one-week session. One focuses on the eye specialist career, and the other unit concentrates on the career field of criminal investigation(crime lab worker).

The crime lab worker unit begins with a discussion of fingerprint patterns, which stuents practice recognizing on a worksheet. Students make their own fingerprints on the second day, following a general discussion by the teacher of the job description, training and salary in this career field. On the third day, students hear an invited guest speaker and complete a detective worksheet on "Who Opened the Refrigerator?" This unit concludes with a field trip and a scientific experiment analyzing the way different fibers look under a microscope.

The unit on the eye specialist begins with the female optician from the Jackson schools visiting the class and providing basic information about careers in this field. On the second day students see a film strip, and following some hands-on experience with a plastic model of the eye, complete a ditto sheet with questions and labeling required. The third day of the unit focuses on experience for the students wherein they are temporarily blinded to appreciate the gift of eyesight. The final two days are spent in scientific experiments, making a spectroscope and conducting an experiment with water and coins to demonstrate the functions of lenses.

GRADE TWO UNIT-DAY ONE

Activities

Pre Test

Invite a resource person to speak to the class(suggested: optician for the Jackson Public Schools, Delores Surbook)

Teacher Materials

Pre Test ditto sheets

Student Materials

None

GRADE TWO UNIT-DAY TWO

Activities

Show filmstrip(suggested: The Amazing Eye, available from the Jackson ISD media center)

Hands-on with Eye Model

Labeling Part of the Eye Ditto Sheet

Teacher Materials

Filmstrip, projector and screen

Eye model from the Jackson ISD media center

"Labeling" ditto sheets for students

Student Materials

None

GRADE TWO UNIT-DAY THREE

Activities

Discussion of Eye Functions

Activity: Pin the Tail on the Donkey

Activity: Identification of Others through Feeling

Teacher Materials

Materials for Pin the Tail on the Donkey

Scarfs for blindfolds(or other material to cover eyes)

Student Materials

None

GRADE TWO UNIT-DAY FOUR

Activities

Scientific Activity:Making a Spectroscope

Teacher Materials

Making a Spectroscope materials(see supplemental materials)

Student Materials

Shoebox from home

GRADE TWO UNIT-DAY FIVE

Activities

Post Test

Scientific Experiment: Lenses

Teacher Materials

Lenses experiment materials(see supplemental materials)

Student Materials

None

GRADE TWO UNIT-SUPPLEMENTAL MATERIALS FOR

EYE SPECIALIST

The following materials are contained in this section:

Labeling the Eye Parts: Ditto Sheet

Activity: Homemade Spectroscopes

Activity: Lenses

Pre and Post Test

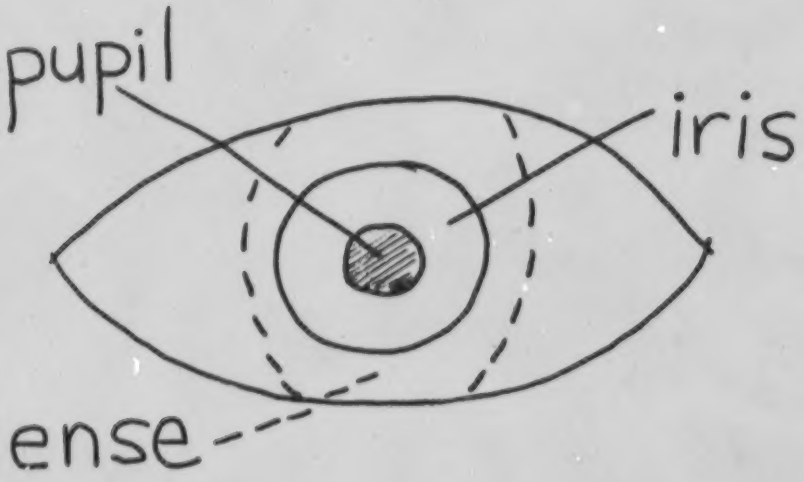
Career Information: Eye Specialist

Additional Readings on Women(for teacher use)

"Women and Light"

Name _____

The Eye Parts



1. The pupil lets ___ into the eye.
   (a) light (b) dark (c) bright

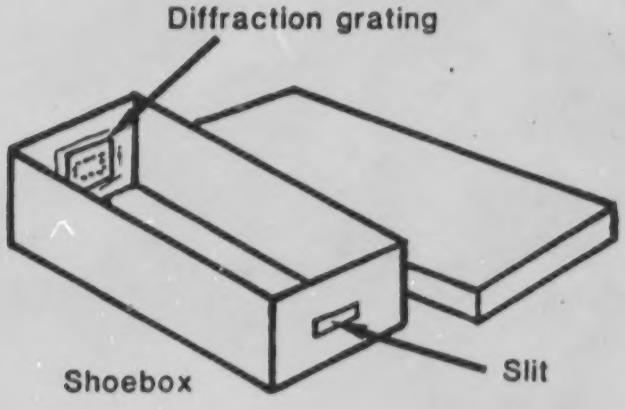
2. The image of objects is ___ by the lense.
   (a) reflected (b) contracted (c) frozen

3. The iris is a protective ___ for the pupil.
   (a) cover (b) shield (c) paper

Extension Activity 5: Homemade Spectroscopes

Materials:

- Diffraction grating, either commercial or homemade.
- Shoebox (one for each available diffraction grating).
- Scissors.
- Tape.
- Knife (preferably one used to safely cut cardboard boxes).



Procedure:

Give students these directions for making a spectroscope. Since the boxes take awhile to make, they probably should be made prior to or following a resource person's visit.

Cut a rectangular slit about one inch long by one-eighth inch wide in the center of one end of the shoebox. Cut a rectangular hole to fit the diffraction grating (about 1" by 1") on the opposite end. Tape the diffraction grating over the hole on the inside of the box. Tape on the top of the box. The only way for light to get into the box, except for the observation slit, should be through the diffraction grating, so tape over all other openings. If a commercial diffraction grating is not available, fairly acceptable results can be obtained by scoring clear plastic sheets (e.g., the type used as report covers) with a very fine needle making parallel, straight scratches as close together as possible.

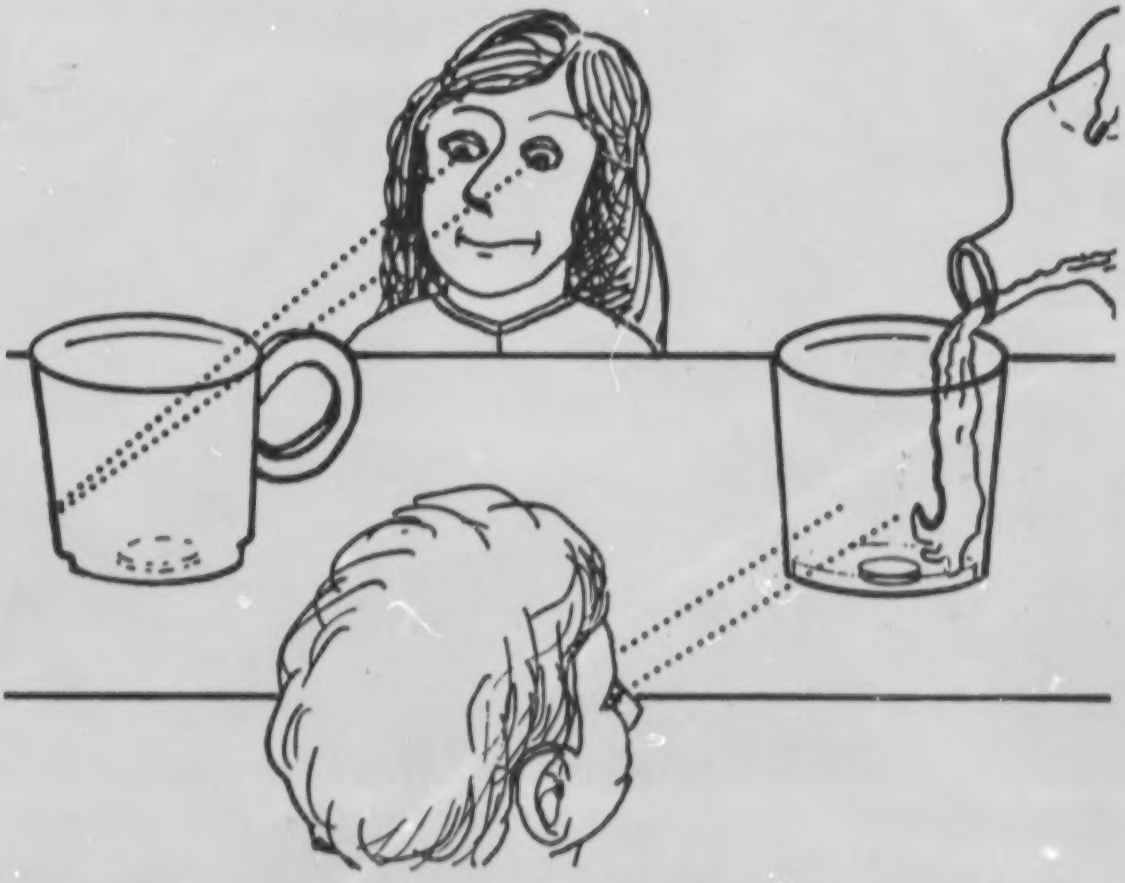
Activity II: Lenses

Materials:

- A clear plastic drinking glass for each student, or if glasses are not available, an opaque cup for each pair of students. The glass should be made so it can straddle a coin placed under it. (This is a good use of used plastic glasses or paper or styrofoam cups. Wash them out and save them.)
- A coin or similar object for each student or pair of students.
- Water.

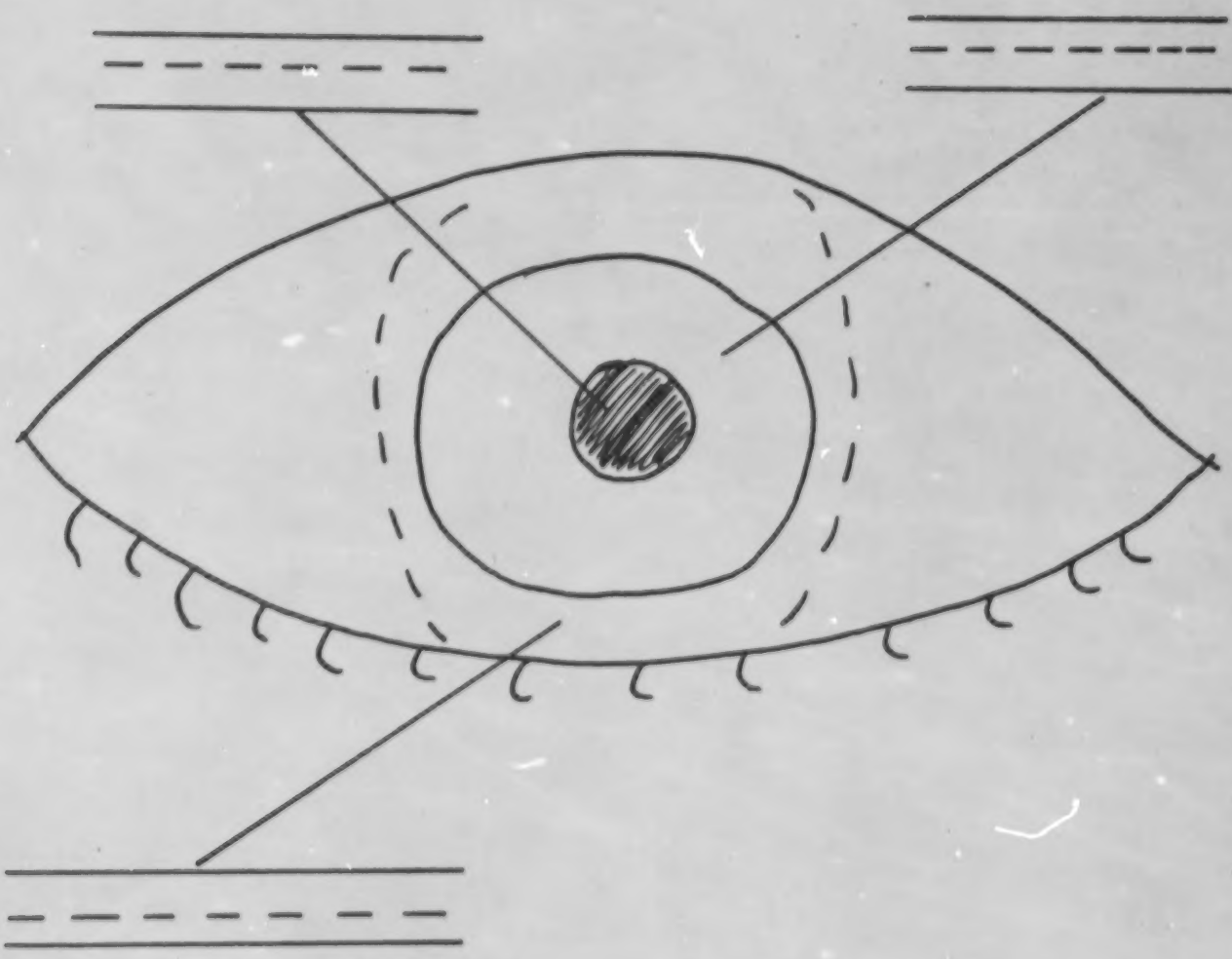
Procedure (Using Plastic Glasses):

Ask each student to place a coin under the empty plastic glass and observe the coin through the side of the glass. The coin should be quite visible. Then ask them to add water to their cup and continue observing the coin. The coin will soon disappear due to refraction (the bending of light when it passes from one medium to another; from air to plastic to water in this case).



Pre and Post Test

Label the parts of the eye.



Name _____

CAREER INFORMATION-EYE SPECIALIST

Job Description

Eye specialist can perform a variety of tasks, depending upon their training. They can design, order and/or fit eyeglasses and contact lenses for patients whose eyesight has been tested by an opthalmologist or an optometrist.

An eye specialist in some cases must be able to read optical prescriptions, measure facial features of a customer, assist the customer in selecting the style and color of eyeglasses, and perform follow-up services such as fixing broken lenses, replacing screws, and adjusting eyeglasses.

Eye specialists can have their own business. They may also work for owners of retail optical outlets, or in an opthalmologist or optometrist's office. They normally work 40 hours a week, sometimes on weekends and evenings. They may also belong to unions and professional associations.

Training

Some eye specialist become certified or liscensed by the State in which they live. Others may make direct application to employers. It is recommended that a person attend an accredited opticinary school if he or she wants to advance in this career field.

Salary

On the average, beginning $12,336 with a college education.

F

Women and Light

Problem. Old photographs fade with age. How can they be rejuvenated?

Problem. Photos of the Orion nebula and other extraterrestrial worlds do not provide enough resolution to make out some significant details. How can these pictures be clarified so that that rich source of information can be harvested?

Dilemma: In order to detect some cancers at an early stage when treatment is most effective, crisp x-rays showing minute details are required. However, to obtain this detail the patient must be subjected to levels of radiation which themselves elevate the risk of producing cancer. Do you choose better detection at the risk of inadvertently producing new cancers; or do you choose to lower the radiation at the risk of overlooking some treatable cancers because of poor quality x-rays?

Barbara Askins' development of a process to enhance underexposed black and white photographs provides a solution for each of these difficulties; and for her work Barbara Askins was recognized as the 1978 Inventer of the Year by the Association for the Advancement of Invention and Innovation. Using Askins' technique, pictures that have been underexposed can be metamorphosed into normal prints that are up to ten times clearer than the originals.

Askins' invention involves immersing the original underexposed film in a low intensity radioactive solution of thiourea sulfur 35 (thi-o-urea). The thiourea sulfur 35 "sticks" to the original film producing an autoradiograph ("self-picture") which emits radiation in the form of beta particles. The autoradiograph can in turn be used to expose photographic film; and presto, an enhanced print of the weak original has been made.

Applications of this process are diverse, as has been indicated by the list of problems it has solved; but one particularly exciting application is in the area of cancer detection. Now, for example, women undergoing "routine" breast x-ray examination can be exposed to <u>safer</u>, lower radiation levels. Using Askins' technique, the resultant underexposed and somewhat fuzzy mammograms can be enhanced to a level of clarity previously available only in x-rays produced with lighter radiation levels. (Controversy, of course, continues over whether any level of radiation is completely safe. Nevertheless, there's general agreement that lower radiation doses are safer; and this lower level may be safe enough compared to the benefits of early detection.)

F

This photographic enhancement technique can be related to the "Lenses" activity which itself can be related to photography and other uses of light.

Another group of women involved with using light energy is composed of a host of astronomers who have contributed quite significantly to that field of study. Caroline Herschel (1750-1847), an English woman, discovered eight comets and several nebulae and star clusters. An American, Maria Mitchell (1818-1889), at age 29 sighted the first comet to be discovered with a telescope, and thereby won a special prize from the King of Denmark. Annie Jump Cannon (1863-1941) is the astronomer whom we feature here.

Cannon's major contribution made in her decades of work at Harvard University was as cataloger of over 300,000 stars and deviser of a system for catagorizing them. Stop for a moment and think about the thousands of stars you can see on a crisp, moonless night. Then contemplate how you might classify all those stars, all the other stars seen only through a telescope, all the stars visible at some other time of the year, plus a comparable number of stars visible only in the southern hemisphere. Annie Cannon took on that task and devised a system which was officially adopted and is still used by the International Astronomical Union and virtually all astronomers.

Cannon's classification system was based on spectrograms, a series of streaks of light produced when light is passed through a prism. By comparing light from a star with light from known materials, one can determine the composition of the star. Also, by comparing the position of these streaks of light in the spectrum with light from a stationary light source, the direction and speed of movement of the star relative to the earth can be determined. To illustrate this latter technique, remind students how the sound of a fast moving car changes as it approaches, passes, and then moves away from the listener . . . probably, perhaps to your chagrin, your students can demonstrate this series of changes in pitch so familiar to race car fans. Similarly, the movement of a light source, such as a star, changes the light's frequency, which we perceive as a change of color. Astronomers measure this color shift to figure out in what direction and at what rate the star is moving; whereas, the race car enthusiast judges the car's movement by the sound shift.

Annie Jump Cannon's contributions can be related to the "Lenses" activity as an application of spectroscopy and photography (virtually all of her cataloging was based on photographic plates) and to the "Illusions" activity. The

connection to "Illusions" can be made by pointing out that the color shift caused by star movement is, in a sense, an illusion. The star produces a certain color of light; but we perceive a different color because of the star's movement relative to the observer.

GRADE TWO UNIT-DAY ONE

Activities

Pre Test

Discussion of Fingerprint Patterns

Teacher Materials

Worksheet #1 for students

Pre Test ditto sheets

Student Materials

None

GRADE TWO UNIT-DAY TWO

Activities

Introduce/General Discussion of Crime Lab Worker Career

Scientific Experiment: Student Fingerprints

Teacher Materials

Suggested filmstrip: The Fascinating World of Law Enforcement, available from the Jackson ISD media center,

Stamp(inked) pad
Scrap paper
Paper towels
Film projector and tape recorder
Fingerprint grid sheets(see supplemental materials)

Student Materials

None

GRADE TWO UNIT-DAY THREE

Activities

Invite Resource Person from the Michigan State Police

Activity: "Who Opened the Refrigerator?"

Teacher Materials

"Refrigerator" worksheets(see supplemental materials)

Consult Jackson Directory of Nontraditional Workers, published by the Jackson Schools Title IX Office.

Student Materials

None

GRADE TWO UNIT-DAY FOUR

Activities

Field Trip (suggested is the Jackson Crime Laboratory)

Teacher Materials

None

Student Materials

Permission slips

NOTES

GRADE TWO UNIT-DAY FIVE

Activities

Post Test

Scientific Experiment: Analyze Fabric Fibers

Teacher Materials

Post test ditto sheets

Scientific experiment sheets(see supplemental materials)

Student Materials

None

GRADE TWO UNIT-SUPPLEMENTAL MATERIALS FOR

CRIME LAB WORKER

The following materials are contained in this section:

Worksheet: Three Basic Fingerprint Patters(teacher use)

Worksheet: "Who Opened the Refrigerator?"

Making Fingerprints: Student Activity

Pre and Post Test

Career Information: Crime Lab Worker

Additional Readings on Women(for teacher use)

"Women and Body Detectives"

"Women and Forensic Science"

Worksheet 1

Three Basic Fingerprint Patterns

Arch

Ridges extend from one side of finger to the other and are slightly raised in the middle.

Loop

One or more ridges make a hairpin turn. Both ends of the loop generally end on the same side of finger.

Whorl

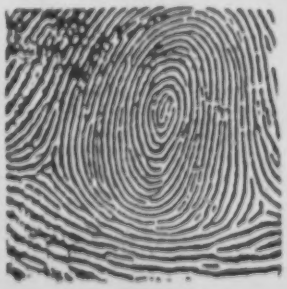
Ridge follows a spinning or circular pattern.

Which of the three basic patterns is each of these ?

A

B

C



D

E

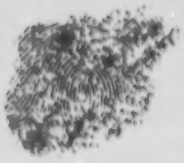
F

Worksheet

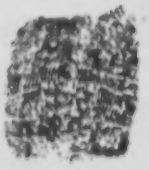
Who Opened the Refrigerator?

Which fingerprint was made by the person whose print was found on the refrigerator?

Fingerprint found on the "off limits" refrigerator.

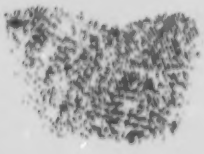


A



B

C



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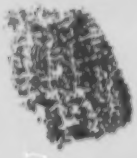

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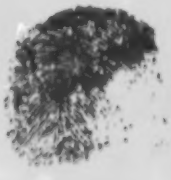

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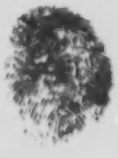

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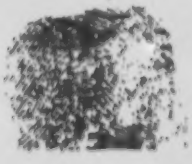

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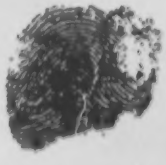
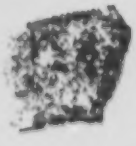


I



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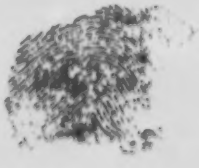

K

Making Fingerprints - Brayer Method:

Spread a thin layer of black printing ink on the linoleum with the brayer. Students should roll the end of each of their fingers one at a time through the ink, getting ink on three sides of their fingers. Next, they should roll their fingers on the appropriate boxes of a worksheet similar to the illustration below (e.g., right little finger in box marked "right little"), getting an imprint of all three inked sides. They should press firmly but not so hard as to smudge the print, and they should make one steady roll of each finger. They should not roll the finger back over the original mark. Each student should work on one finger at a time, inking, imprinting, and wiping it off before proceeding to the next finger. They probably should practice their technique on scrap paper before proceeding to making a "good" set of prints.

Make a print of each finger where indicated.

1. RIGHT THUMB	2. RIGHT INDEX	3. RIGHT MIDDLE	4. RIGHT RING	5. RIGHT LITTLE
6. LEFT THUMB	7. LEFT INDEX	8. LEFT MIDDLE	9. LEFT RING	10. LEFT LITTLE

Name _____

Directions: Match the fingerprints that are alike.

A.

B.

Pre and Post Test

CAREER INFORMATION-CRIME LAB WORKER

Job Description

A crime lab worker applies scientific principles to the analysis, identification and classification of various materials and other physical evidence related to a crime. The crime lab worker may also be responsible for preparing reports and presentations of scientific findings. The crime lab worker may also be called to testify in court and act as an expert witness in the prosecution of a crimimal.

Women and Body Detectives

Materials in amounts as minute as one trillionth of a gram (.000000000001 g)[1] may significantly affect how the body works. However, the detection of such very small amounts of hormones and other chemicals in the body has been possible only in the last 20 years because of the pioneering work of Dr. Rosalind Yalow and her colleagues in development of radioimmunoassay, RIA. Prior to the development of RIA, the presence or absence of these materials was thought to be inconsequential. It's interesting to note this example of "out of sight, out of mind." Until Yalow's RIA technique became available to diagnosticians and researchers, the effects of so-called "trace materials" were largely ignored, since they couldn't be measured. For her work, Rosalind Yalow received the 1977 Nobel Prize in Medicine.

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*How big is one trillionth of a gram? Good question. It's called a picogram, pg; but how can it be visualized? First, think of cigarette ads which talk about milligrams, mg, of tar and nicotine. They make a mg sound small; and it is. A drop of water weighs 50 mg. But a mg is one billion times larger than a pg! (Actually, "weighs" is incorrect; we should say "masses," but "weighs" is sufficient for our purpose here.)

Look at a picogram another way. Finding a picogram in a drop of blood is like finding a raisin in a circular swimming pool that's chest deep in water and nearly four football fields in diameter. Good grief! How could we find the raisin? Let's assume that to be certain we found the raisin, we'd have to assign one person to search a volume of water in this pool 3 feet by 3 feet by chest deep (about 50 cubic feet). To cover the whole pool, we'd need 10,000 people to do the searching! Or let's assume that one person could each day search 50 cubic feet of water. Covering the pool at that rate would take a person over 27 years . . . . . with no vacation.

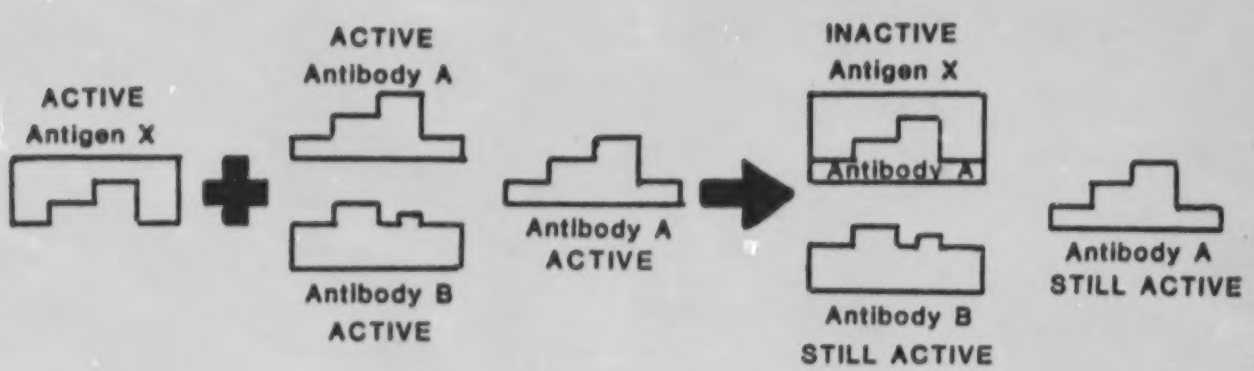
Here's another way to look at a picogram. This spot is about 1 mm on a side □. If this spot were located on a piece of paper about ten football fields in area, then finding that spot on the paper would be like finding one picogram in a drop of blood.

Some students may be satisfied to simply know that Yalow developed a means to measure small amounts of materials which affect the body's health. For them you can skip to the subsection, "RIA's Applications." Other students, especially those more adept in math, may be interested in a further explanation of RIA as an application of math and science to medicine.

How RIA Works:

Breaking the word, radioimmunoassay, down into its three constituent parts helps explain Yalow's technique. "Assay" refers to the fact that RIA is used to quantify how much of a particular material is present in a particular sample, say a blood sample. (From watching westerns on TV, your students may be familiar with gold prospectors who took their ore to the assay office to determine how much gold was contained in the ore.)

The "immuno" part of RIA comes from immunology, the study of how the body fights off foreign invaders, such as bacteria. In immunology, the foreign material is called an antigen and the material produced by the body to combat the antigen is called an antibody. It is assumed that for each antigen there is a specific antibody which will render the antigen inactive. Often the antibody clumps together with the antigen; and it's this type of interaction that's taken advantage of in RIA. An antigen is frequently, but not always, a protein. The antigen could be a part of a bacterium or virus, a chemical secretion of another individual, or a tissue transplant. In the diagram antigen X specifically combines with antibody A, but not antibody B. One unit each of antibody and antigen will combine; any excess of antigen or antibody will remain free and active.



Finally, the "radio" part of RIA refers to the use of radioactive materials. The amount of a radioactive material can be measured by counting how much radioactivity the material exhibits. More radioactivity means more material; less means less. Your students may be familiar with Geiger Counters which are used to measure amounts of radioactivity.

The trick now is to put all this together; and that's what Yalow did. (While reading about RIA, refer to the diagram following page 6 which can be made into an overhead.) Three ingredients are mixed:

(1) An unknown amount of some substance (antigen). This is the material which is to be quantified.

(2) A known amount of the antibody for that substance.

(3) A known amount of the antigen tagged with a radioactive isotope. (One could tell how much radioactive antigen is added by measuring its radioactivity.)

The antibody clumps together with both the radioactive and normal antigen until all the antibody is used up. Thus, some uncombined, radioactive and nonradioactive, antigen is left over and it can be separated from the clumped antigen. The amount of leftover, uncombined radioactive antigen can be found by measuring its radioactivity.

Now there's a little math, which can be explained by example and reference to the diagram. Let's assume that originally 300 units of antibody A were mixed with 300 units of radioactive antigen X plus an unknown amount of the nonradioactive antigen X. (We can see how much unknown is in the diagram, but that's not known to the experimenter.) We allow the antigen-antibody clumping to take place and separate out the radioactive antigen X that remains. Our measurements with a Geiger Counter show that there's 200 units of leftover radioactive antigen X. By subtraction we calculate that 100 units of radioactive antigen clumped with the antibody.

300 units of radioactive antigen X originally mixed.
- 200 units of radioactive antigen X which were left over.
100 units of radioactive antigen X clumped with the antibody.

Since all the antibody was combined and since 100 units of antibody combined with radioactive antigen, then by substraction (300 - 100) there must have been 200 units of nonradioactive (unknown) antigen combined with the antibody.

We now use a ratio. Note that twice as much nonradioactive antigen X (200 units) as radioactive antigen X (100 units) combined with the antibody A. Therefore, there must have originally been twice as much unknown antigen X as known, radioactive antigen X.

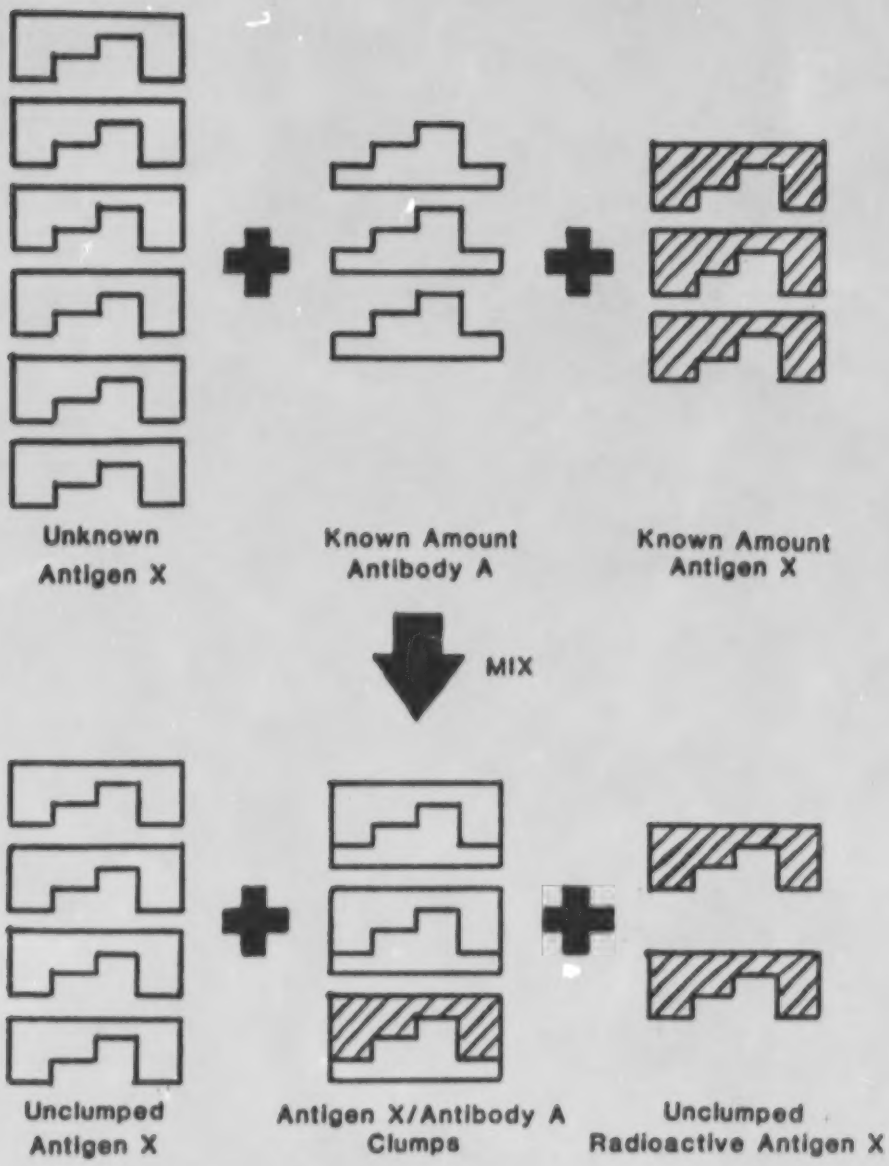
$$\frac{\text{200 units nonradioactive antigen X}}{\text{100 units radioactive antigen X}} = \frac{\text{2 units}}{\text{1 unit}}$$

Since we know that we originally added 300 units of radioactive antigen X, there must have been 600 units of unknown, nonradioactive antigen X (2 x 300 units).

RIA's Applications:

The uses of RIA both as a diagnostic tool and as a research procedure are legion. For example, when trying to unravel the mechanism whereby hormones produced in the pituitary gland regulate activity in, for example, the ovary, microscopic amounts of these pituitary hormones must and can be detected. RIA has also been used to detect hepatitis virus in blood earmarked for transfusion, thus preventing the inadvertent spread of the disease. In criminology work, RIA can be used to determine the source of blood, perhaps under a victim's fingernails, thus potentially linking the offender with the crime.

Rosalind Yalow's development of radioimmunoassay can be related to either "Unseen Chemicals" or "Sugar Present." Whereas your students use color changes to detect the presence of chemicals in a solution or in urine, Yalow applied her knowledge of physics and medicine to find and quantify unknown chemicals using radioactivity. For more information about Rosalind Yalow and her work, refer the interested student to Women Pioneers of Science by Louis Haber (New York: Harcourt Brace Jovanovich, 1979).



(Each symbol represents 100 units.)

Rosalind Yalow's Radioimmunoassey Technique, RIA

L

Florence Sabin

Although Rosalind Yalow won her Nobel Prize during her lifetime (the Nobel is always awarded to a living person), Dr. Florence Sabin received one of her greatest honors posthumously. Each state is allowed to recognize one, and only one, of its citizens in the Statuary Hall in the Capitol Building in Washington, D.C. The state of Colorado chose to so honor Florence Sabin primarily for her public health work which she began when she was over 70 years old and after a long and distinguished career as a medical researcher and teacher.

During her outstanding medical schooling, from which she emerged in 1900 as Johns Hopkins University's first woman M.D., Florence Sabin completed a detailed study of the brain; and then she devoted herself to unraveling the mysteries of the lymphatic system and later, blood cells.

Her research work was widely recognized; but it was only after her retirement that she completed the work for which her state honored her. She was appointed in 1944 to head Colorado's governor's public health committee. Due to her vigorous and thorough work, laws were passed and procedures were modified, resulting in the lowering of Colorado's death rate from one of the highest to one of the lowest in the country. At 78 she became head of Denver's health department; and during her three year term she eradicated the city's rat problem, improved sewage disposal, set up free x-ray locations, and ensured the sale of pure milk throughout the city.

While studying "Spare Parts," you or the resource person could relate the story of Dr. Florence Sabin, who devoted most of a lifetime to the study of the body and then capped off an already full life with outstanding public service. Your students may want to find out more about Dr. Sabin by reading Proving the Unknown: The Story of Dr. Florence Sabin by Mary Kay Phelan (New York: Crowell, 1969) or the shorter and easier to read Women and Science by Valjean McLenighan (Milwaukee: Raintree Publishers, 1979).

D

Women and Forensic Science

Cathy Thomas is a forensic scientist who specializes in serology, the analysis of body fluids, including blood, perspiration, saliva, and seminal fluid, which are among the principle sources of physical evidence used by police to solve crimes. As an undergraduate she majored in chemistry and biology; and in graduate school she started in biochemistry but turned to forensic science, a closely related field. She has taken postgraduate work at Scotland Yard, where the British have developed blood analysis procedures which can nearly distinguish one individual's blood from another's. Similarly they can categorize fingernails.

More crime labs are being built or expanded in recent years for several reasons. One, court decisions have limited the use of interrogation of suspects by police, so police have had to depend more heavily on physical evidence. Two, new crimes, such as drug trafficing, have appeared and require new techniques in their detection. Three, new, sophisticated chemical and physical analytical techniques, each requiring specialized training, have been developed. Finally, money for these laboratories has been made available to many local jurisdictions by the states and especially the federal government.

The crime lab employs some or all of a host of tests with exotic sounding names: ultraviolet and infrared spectrophotometry (see Light and Sight for information about how Annie Jump Cannon used similar information to classify stars), neutron activation analysis, gas chromatography, differential thermal analysis, and radioimmunoassay (see Body Detectives for information about Rosalind Yalow's development of this technique). These new techniques require that police also be more sophisticated in gathering evidence. Some larger forces are even employing evidence technicians who specialize in gathering physical evidence so that nothing is overlooked and so that the evidence is preserved in a form that can be tested in the lab. Cathy Thomas occasionally has been called to the site of a homicide to collect evidence. It's not a pretty scene, but one to which she has accustomed herself.

Cathy Thomas not only collects evidence and performs serological examinations but also testifies in court as an expert witness on her findings. Thus, the work of Cathy Thomas demonstrates the breadth and sophistication needed by the modern crime laboratory worker.

Have each student make a set of their own fingerprints and an extra copy of their own right index finger. Have them classify each of their prints into one of the three basic patterns: arch, loop, or whorl. They may want to use a hand lens to help in the process. Since some prints may not clearly fall into one of the three categories, advise students not to be too concerned if they can't identify all their prints. Ask students:

- Do all of your fingers have the same basic fingerprint pattern?
- Do fingers on your left hand have the same pattern as identical fingers of the right hand? For example, if the right middle finger is a whorl, is the left middle finger also a whorl?
- If fingers on the right and left hand have the same pattern, is one the mirror image of the other?

Distribute the "Who Opened the Refrigerator?" worksheet and ask students to figure out which of the suspects, A through K, is the culprit. You may want to guide their application of a logical, empirical problem solving method. First, they should identify the basic pattern of the print found on the refrigerator. (It's a whorl.) Next, they should figure out which of the suspects has a whorl pattern. (A, C, D, and K have the whorl pattern and thus have become "prime suspects;" the others are no longer suspects.) Next, students should look more closely at the whorl pattern found on the refrigerator for distinguishing characteristics. They may note the long central line in the middle of the unknown's whorl. (A and D have a short central line which is almost a dot, so A and D are eliminated. C and K remain as "prime suspects" because they do have the long central line.) Finally, the students can see that the whorl of the refrigerator raider spirals in a clockwise direction. To see this, have students look at the center of the whorl and follow a ridge as it spirals outward. (C's whorl spirals counterclockwise, and K's whorl spirals clockwise. By a process of elimination, K has been identified as the refrigerator raider.)

If you have done binary classification activities from Information Manipulation or have done other binary classification activities (e.g., used a dichotomous key), you can point out that those classification skills were being used here. That is, a series of characteristics were observed and the fingerprints were divided into two groups, those with and those without the characteristic. Each new observed characteristic further subdivided the fingerprints until only the remaining print had all of the characteristics that matched the raider's print.

D

As a final activity, students' ten prints with their names on their own prints and their unnamed right index fingerprints could be put on a bulletin board or some comparable place. As students have time while others are doing other activities, they can match the unnamed with the named prints. To speed this process, you may want to subdivide the prints into groups of, say, five; otherwise, an unnecessarily lengthy matching process may detract from the central purpose of teaching classification skills.

CAREER PROGRAM ON SCIENCE:

GRADE THREE UNIT

Emphasis: Life Science

Career(s): Medical Technologist
Veterinarian

Developers: Mary DeLaet
Gertrude Rieger

GRADE THREE UNIT-OVERVIEW

The one week unit concentrates on two careers: medical technologist and veterinarian. The emphasis on the first day includes information about the role of women in the world of work(in general) and then includes specific information on the description, training and salaries in these two career fields. At the conclusion of the first day, a resource speaker is invited to talk to the class about various opportunities in the medical technology field.

Following a review of the first day, a filmstrip on veterinary medicine is shown on the second day, and students use a worksheet to become more familiar with the vocabulary of the two career fields.

A resource person(female) from an animal clinic is invited to speak to the class on the third day. In addition students perform scientific experiments which stress keeping healthy. They may also experiment with hands-on activities involving test tubes, microscopes,slides, etc..

Another female resource speaker is included in the fourth day of the unit. In addition students begin a class project to construct a skeleton. The unit concludes with a pet show for the class.

GRADE THREE UNIT-DAY ONE

Activities

Pre Test

General Discussion of Women in the World of Work

Specific Discussion of Careers(medical technology and veterinary medicine)

Invite resource person from the Red Cross Blood Bank

Teacher Materials

Pre Test ditto sheets

Suggested: Chronicle Guidance Publications Leaflet #238 and Leaflet #16

Occupational Outlook Handbook, U.S. Dept. of Labor, Government Printing Office, Washington

TABS Career Posters(available in each elementary building)

Student Materials

None

GRADE THREE UNIT-DAY TWO

Activities

Short Review of Day I

Filmstrip: The Fascinating World of Veterinarians, available from Jackson ISD media center.

People Who Work in Science, available from REMC

Vocabulary List Worksheet

Teacher Materials

Vocabulary worksheet(see supplemental materials)

Suggested: Encyclopedia of Careers and Vocational Guidance, "Health Occupations"available in Jackson High School library

Student Materials

None

GRADE THREE UNIT-DAY THREE

Activities

Invite a Resource Person(female) from a local hospital or animal clinic

Scientific Experiment: Keeping Healthy

Scientific Experiment(alternative): Hands-On with Test Tubes, Microscopes, Slides, Petre Dishes, etc.

Teacher Materials

"Keeping Healthy" materials(see supplemental materials)

Student Materials

None

GRADE THREE UNIT-DAY FOUR

Activities

Invite Resource Person(suggested: Dr. Ann Gage or female associate of Dr. Kaser)

Student Activity: Construct a Skeleton

Teacher Materials

"Construct a Skeleton" materials(see supplemental materials)

Student Materials

None

GRADE THREE-DAY FIVE

Activities

Post Test

Pet Show

Teacher Materials

Post Test ditto sheets

Paper towels

Kitty litter

Student Materials

Note of understanding between parent, student and teacher regarding responsibilities for the pet show.

GRADE THREE UNIT-SUPPLEMENTAL MATERIALS

The following materials are contained in this section:

Vocabulary List: Veterinarian(to be used with filmstrip)

Vocabulary List: Laboratory Technician(to be used with filmstrip)

Health Occupations(for teacher use)

Exploring Careers(for teacher use)

Keeping Healthy: Student Activity

Finding Your Pulse, Different Pulses, Breathing:Student Activities

Construct a Skeleton:Student Activity

Pre and Post Test

Pre and Post Test Key

Career Information: Medical Technologist

Career Information: Veterinarian

Addititional Readings on Women(for teacher use)

"Women and Health"

Vocabulary List

Veterinarian

antics

income

research

microbiology

disease

constitution

D.V.M.

diagnosis

observation

force

vet

Vocabulary List

Laboratory Technician

evidence

drugs

grooves

finger prints

saliva

microscope

illegal drugs

substance

chemicals

ballistics

heroin

chemist

Another friend of mine, Wanda, works in the blood bank. Wanda and I talk about our jobs a lot. One of the things we both like is that our jobs rarely intrude on our personal time. In short, we leave our work in the laboratory. Wanda and the other technologists in the lab draw blood from blood donors—healthy people who donate blood to the blood bank. This blood is refrigerated in plastic bags and usually stays healthy for 21 days. The laboratory receives patients' blood samples in tubes from other parts of the hospital or from private physicians. These patients often are scheduled to undergo surgery, and doctors need to have blood available for transfusions. Medical technologists in the blood bank must find donors' blood that is compatible with patients' blood samples sent to the lab.

Technologists perform chemical tests to determine the type of blood in the sample. Blood may be typed A, B, AB, or O. In addition, technologists must determine the Rh factor as Rh positive or Rh negative, referring to the presence or absence of certain inherited substances in the red blood cells. The technologists then find stored blood that matches the blood in the patient's sample, and retest it as a precautionary measure. To be usable, the stored blood must be exactly like the patient's blood. In the event that no compatible blood is in storage, the technologists would contact the Red Cross to obtain the appropriate type.

Accuracy is essential in the blood bank and the workers here are under great pressure to avoid mistakes. A mistake by a laboratory technologist can kill a patient. Take the case of someone in an automobile accident who needs emergency surgery. If the lab made an error in testing and the patient received the wrong blood during the operation, he or she could die. That's an awesome responsibility.

Last fall I was invited to supervise some medical technology students who were doing their senior year clinical rotation in the biochemistry department here. I was surprised to discover how much I enjoyed teaching! I'm thinking of going back to school for a master's or Ph. D. so that I can teach full time in a college or university program in medical technology. But that's a pretty big step, after all.

Although my job can be routine at times, I know enough science to understand what the tests really mean. Once I've run some tests, I usually have an idea of what's going on inside the body of a patient with this or that disease. That makes the work interesting, and I don't know whether I want to give it up to teach.

And another thing. If I went into teaching, I might miss the day-to-day contact with the hospital staff. I like being part of the team effort here to help sick people. Well, I guess I'll have to give it a lot more thought.

Exploring

Medical technologists must have a strong interest in science.

- Do you like science? Are you interested in biology and chemistry?
- Do you like to do laboratory experiments in class or on your own?
- Do you pursue science projects independently?
- Have you ever entered a science fair?
- Are you curious about the unknown?
- Do you like to study things under a microscope?
- Do you like to experiment with chemistry sets?

Medical technologists must be very accurate. Sometimes they are under pressure to work quickly, but they must be precise just the same. A patient's life might depend on it.

- Do you check your homework for errors?
- Do you check your answers on a test before handing it in?
- Do you do things in a methodical way?

Medical technologists must have an eye for detail. They have to detect even the slightest variations in the samples they examine.

- Do you enjoy identifying trees, leaves, or birds?
- Do you collect and identify sea shells?
- Can you tell that something is missing from your room?
- Can you find a place on a road map quickly?
- Do you like to do word-finds and other games where you must find hidden objects in pictures?

Medical technologists need manual dexterity to handle medical equipment such as test tubes, slides, and microscopes.

- Do you like working with your hands?
- Do you enjoy building models, setting up electric trains, framing pictures, making ceramics, making electronic equipment from a kit, or working with photographic equipment?
- Are you accustomed to using tools for work around the house?
- Are you good at setting up displays for class projects or school exhibits?

Medical technologists don't spend much time with patients. They work with laboratory equipment instead.

- Do you like building things?
- Do you like collecting things?
- Do you enjoy class assignments that involve working with scientific equipment?

Medical technologists must be able to follow strict laboratory procedures.

- Do you pay attention to instructions when you're taking a test or doing a homework assignment?
- Are you good at following a recipe?
- Do you use patterns for sewing, knitting, or needlework?
- Do you follow the instructions carefully when you mix chemicals from your chemistry set, build a model, or assemble electronic equipment from a kit?

Medical technologists are members of a health care team. They must work well with others.

- Do you enjoy working with other people on class projects? Do you accept your share of the responsibility?
- Do you like working with others on school clubs or committees?
- Do you like team sports?
- Do you like to organize group activities such as parties, sports events, picnics, and dances?

Medical technologists must be concerned about good health.

- Do you eat a well-balanced diet?
- Do you see the dentist regularly?
- Do you get enough sleep?
- Do you pay attention to warnings about alcohol, drug, or tobacco abuse?
- When you ask someone how he or she is feeling, are you really concerned or do you consider it a social custom?

Medical technologists keep up with the field by reading professional literature and attending lectures and conferences.

- Do you like to read for pleasure?
- Do you like to read popular science magazines? Do you read articles on medicine and health in magazines and newspapers?
- Do you show initiative in doing research on subjects of personal interest?
- When you are curious about something, do you go to an encyclopedia or library to learn more about it?
- Do you look up words you don't understand in a dictionary?
- Do you like to browse in the "new books" section of your library?

Suggested Activities

Stimulate your interest in science by reading and doing experiments or projects.
- Work with a chemistry set, the kind available in hobby shops or department stores.
- Prepare slides and examine them under a microscope.
- Do a project in the life sciences for a science fair.
- Read popular science magazines.

Join a Science Club or a Health Careers Club if there is one in your school.

Contact your local chapter of the American National Red Cross to arrange a talk for your science or health class on the Red Cross blood program.

Ask your teacher to arrange a class tour of a medical laboratory.

Invite a medical technologist to speak to your class about his or her job. Ask the speaker to bring and explain some of the equipment used in a medical laboratory. Ask him or her to talk about job duties, training, and the rewards and frustrations of this kind of work.

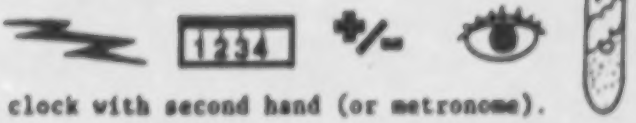
Volunteer to work in the medical laboratory of a hospital, clinic, or nursing home. You might be able to run errands, wash equipment, or do clerical work.

Get in touch with the American National Red Cross about opportunities to work as a youth volunteer. Red Cross youth volunteers help recruit blood donors, serve as tutors for younger children, and as aides in hospitals, day care centers, and nursing homes.

Join an Explorer Post if there is one in your area. Exploring, open to young men and women aged 14 through 20, offers programs in medicine and health careers, physical or natural science, and emergency first aid. To find out about Explorer posts in your community, call "Boy Scouts of America" listed in your phone book, and ask for the "Exploring Division."

If you are a Girl Scout, earn a proficiency badge in Science, Public Health, or First Aid.

Activity I: Keeping Healthy



Materials:

- One watch or clock with second hand (or metronome).
- Bench, step, or pile of lumber of appropriate height for each student doing activity.

Procedure:

This activity emphasizes health and the physician's or other health resource person's recognition of a person's state of health. Dr. Virginia Apgar's test of infant fitness is described in Women and Medicine and should be mentioned to your students. However, this activity deals with your students' physical well being.

Some caution is required, but almost all your students should be able to perform the Harvard Step Test of physical fitness (see Olney, Ross. The Young Runner. New York: Lathrop, Lee & Sheppard. 1978), which is the basis of this activity. Your students should not perform this test if they have been told by a doctor that they have, or have had, a heart problem, high blood pressure, or bone or joint problems that might be aggravated by exercise, if they have frequent heart or chest pains, faintness, or dizziness, or if for any other reason they feel they shouldn't do the activity. Perhaps you could ask for a few volunteers to do the test, so that everyone unable to do the test would simply be a part of a large group of nonvolunteers and thus avoid embarrassment.

The test should take 15-20 minutes once the materials are ready. Find a sturdy bench 12 inches high (if the person doing the test is under 5 feet tall), 14" high if the person is 5' to 5'3", 16" if 5'3" to 5'9", 18" if 5'9" to 6', and 20" if over 6'. Before starting, tell the students they should stop if they become too tired. If a number of students perform the test simultaneously, assign each one a partner to record the data. Prior to doing the exercise have students practice finding their pulse and emphasize precision in doing the activity. See Finding Your Pulse, Extension Activity 1, page 7. If the resource person is going to have students perform the Harvard Step Test, then prior to the visit you probably should teach students how to take their pulse, in order to save time for the resource person.

At your command students step (not jump) from the floor up to the bench and back to the floor repeatedly, 30 times/minute for four minutes. Accurate counting is important; use a metronome or watch the clock to call out the cadence loud enough for each to hear. IF STUDENTS GET TOO TIRED, THEY SHOULD STOP. Of course, their score will be lower if they stop short of four minutes, but that's what the test is all about.

When the four minutes are up, have the students sit quietly and take their pulse beginning one minute, two minutes, and three minutes after the the end of the exercise. Each time they should count their pulse for 30 seconds. Calculate the RRI, Recovery Rate Index, using the following formula.

$$\text{RRI} = \frac{\text{Duration of exercise in seconds} \times 100}{\text{Sum of the three 30 second pulse counts} \times 2}$$

For example, if the person exercised for the entire four minutes (i.e., 60 seconds/minute x 4 minutes = 240 seconds) and had a 30 second pulse rate of 62 after one minute, 48 after two minutes, and 45 after three minutes (62 + 48 + 45 = 155), their RRI would be:

$$\text{RRI} = \frac{240 \times 100}{155 \times 2} = \frac{24000}{310} = 77.4$$

A rough interpretation of the RRI in terms of physical fitness can be derived from the following chart. Note that some physiologists have found the Harvard Step Test not useful for their research; but this chart can show students how higher scores are associated with better physical fitness.

< 60 - poor
61 - 70 - fair
71 - 80 - good
81 - 90 - very good
> 90 - excellent

Discuss the results, bringing out the facts that the blood carries oxygen which is involved in fulfilling the body's energy needs. When a person exercises, more oxygen is needed, so the heart beats faster to get blood distributed more quickly. By strengthening the cardiovascular system through a regimen of exercise, more blood can be circulated per heart beat and therefore fewer heartbeats are needed to supply the oxygen needs.

Under the direction of a physical education teacher or someone else knowledgeable about physical fitness programs for your age students, your students could enter into a physical fitness program and later (say, after three months) repeat the test.

Your physician resource person could comment on what bodily functions go into "physical fitness" as measured by the RRI and stress the importance of fitness for good all-around health. Our increased life span is not due as much to wonder drugs, surgical procedures, and new apparatus as it is to improved diet and the nearly total control of disease causing organisms.

Extension Activity 1: Finding Your Pulse

Materials:

- Wooden match or toothpick for each student (optional).
- Small piece of clay for each student (optional).
- One clock with second hand for all to see.

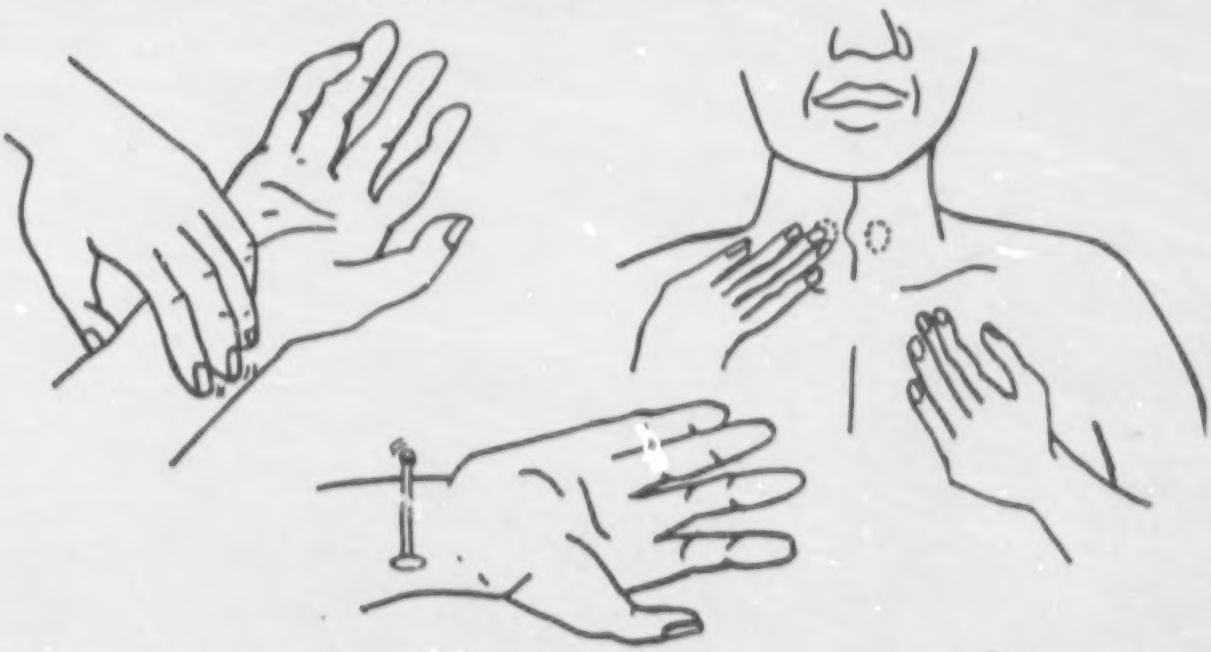
Procedure:

The heart is the strongest muscle in the human body. It can be thought of as two pumps working side by side. The right side pumps blood to your lungs where oxygen is picked up. The left side pumps oxygen-rich blood to the body.

A heartbeat can be heard, but the pulse must be felt. When the heart contracts, blood surges through the arteries which are elastic and swell in response to this surge of blood. When the heart relaxes, the surge of blood is reduced and the arteries return to their former diameter. Thus, the heart's rhythmic pattern of contractions and relaxations is perceived indirectly by feeling the expansion and contraction of arteries.

There are several spots on the human body where the arteries are close to the surface. These spots are called pulse points. (See HEALTH HELPERS, Activity III, "Emergency," for a drawing of these points.) The two that may be the easiest to find are on the wrist and the side of the neck.

Gentle finger pressure on the wrist is commonly used to measure the pulse rate. However, a toothpick or match fastened with clay over the artery in the wrist will move in a "throbbing" motion with each pulse. Either method may be used by the students. The pulse also can be felt in the neck to the right or left of the "Adam's Apple." Pressure should be applied gently, but in increasing amounts, until the pulse can be felt. If students have difficulty, ask them to do a little exercise (e.g., stand up and sit down 5-20 times) and then feel for their pulse which should become more pronounced through exercise. Because the thumb contains a pulse itself and thus makes it hard to use to get a good reading, be sure the students use their finger tips, <u>not</u> thumbs, to measure pulses.



Have students measure their own pulse (for perhaps 15 seconds or 30 seconds) and that of someone else while sitting at their desks. Record the values on the chalkboard. Be sure to have students determine the number of pulses per minute. Multiply by four or two, if they measured for only 15 or 30 seconds, respectively.

Extension Activity 2: Different Pulses

This activity is especially good as a follow-up to the resource person's visit. As an assignment for outside of class, have the students collect data to answer one or more of the following questions, which also appear on Challenge Cards, which could be duplicated and distributed to students.

- Do younger people have faster heartbeats than older people? (Include babies and senior citizens in the sample, if at all posible. Check answers with Table 1.)
- Is pulse rate related to body size? (Comparisons should be made involving animals also. Students can measure heartbeats of pets as well as do library research on heartbeat rates for various animals. Check answers with Table 2.)
- Do people who smoke have a different pulse rate than people of approximately the same age and size who do not smoke?
- Do pulse rates change during the day (under similar activity)? For example, a comparison could be made in the morning, after meals, and before going to bed.

Age	Approximate Pulse (Beats per Minute)
Baby	135
5 yr.	110
13 yr.	90
20 yr.	75
50 yr.	70
70 yr.	75

Table 1
Heartbeat and Age

Animal	Approximate Pulse (Beats per Minute)
Elephant	25
Horse	50
Human	75
Dog	100
Rabbit	175
Mouse	500
Shrew	1000

Table 2
Heartbeat and Size

Extension Activity 3: Breathing

Perform investigations similar to those in Extension Activity 2 using breathing rate rather than pulse rate as an indicator. Is there any correlation between breathing rate and pulse rate?

Construct a Skeleton

Materials:

- Skeleton from chicken, turkey, rabbit, pigeon, or whatever animal is available. (Chickens, turkeys, and rabbits are available; but since they often are young skeletons - so the meat would be more tender - they may disintegrate too easily in preparation. Therefore, wild birds, such as a mature pigeon, may work better, since the bones will be harder; but use larger birds with larger bones. Perhaps a local bird watcher or hunter could supply a cleaned carcass with all internal organs and most meat removed.)
- Poster board (preferably black or other dark color).
- Glue and/or wire.
- A copy of the chicken skeleton diagram on page 6 (optional).
- Paring knife.
- Pot.
- Stove or hot plate.
- Wat[illegible].
- Soap.
- Old toothbrush.
- Bleach.

Preparation of Skeletal Materials:

If there is no collection of bones available at your school, the local market may be a good source. Whole chickens or rabbits can be used to provide nearly complete skeletons. These specimens unfortunately usually lack heads and feet, but the activities in this module do not require those parts. In all other meats (except fish) the available cuts include only disjointed or cut bones. However, the butcher may be willing to save some articulated joints or vertabrae from which the marketable meat has been trimmed.

The quickest way to prepare fresh bones for study is to boil off the meat. Immature and very small animals have many soft bones. These, as well as joint connections, may disintegrate with boiling. Thus, a mature stewing or roasting chicken may be the best choice. If time allows, students may be involved in the preparation of bones for study. A chicken lunch may be an added attraction with the cooking done at school.

To prepare the chicken, or other small animal, remove the skin and boil the whole carcass slowly until the meat begins to lift from the bones. Removal of the meat can be speeded by cutting off large portions of the meat prior to boiling. Use a paring knife and fingers to remove the meat. If possible, leave some of the joints, rib cage, and vertabrae connected. Collect the bones and wash them gently in soapy water to remove grease and allow them to thoroughly dry. Bones can be soaked in bleach to brighten their color. Caution students about exercising care with bleach.

Students should <u>not</u> be encouraged to bring in carcasses found in the environment unless <u>all</u> flesh has decayed from the bones, as the decaying carcasses may be sources of disease. Furthermore, it is illegal to pick up or possess the remains (including feathers) of <u>any</u> wild bird except house sparrows, starlings, and game birds legally collected with hunting licenses.

<u>Procedure:</u>

This activity takes quite a bit of time and should therefore precede or follow the resource person's visit. One or two students may want to do this activity as a special project. When studying bones, the work of Dr. Julie Glowacki in making new bones can be related (see "Women and Bones"). Have students do the following.

Prepare the chicken or other animal bones. Identify the bones, using the illustration on page 6 as a key, and lay out the bones with the head up and each wing and leg off to one side or the other. These bones can be glued and/or wired to poster board, and each bone can be labeled. (Smaller bones can be glued, but larger bones should be wired in place.)

For a more ambitious project, students can use wire, pins, and glue to assemble the entire skeleton. However, caution students that this is a fairly time consuming project.

GRADE THREE-PRE AND POST TEST

1. Can women choose any career they want?

   Yes No

2. Name three nontraditional careers in science for women.

3. Can men choose any career they wish?

   Yes No

4. Name three nontraditional careers in science for men.

5. What are some of the training requirements for one of the careers you listed above?

6. What does a medical technologist do?

7. Where might a medical technologist work?

8. What does a veterinarian do?

9. Where might a veterinarian work?

10. (Post test only) From what you learned in this unit, which careers would you choose? Why?

GRADE THREE-PRE AND POST TEST KEY

1. Yes

2. Medical technologist, veterinarian, engineer, geologist, and dentist

3. Yes

4. Nurse, dental hygenist, medical records cler, medical secretary, and physical therapist

5. Technologist needs some post high school training. Veterinarian needs college education and post graduate study.

6. Tests patients' blood samples, uses electronic computers, uses microscopes to observe changes in blood, conducts chemical tests and recoords this information

7. Clinics, bioanalysis laboratories, pharmaceutical companies, insurance companies, public health departments and federal and state departments

8. Prevents and treats animal diseases and illnesses

9. In rural areas, often outdoors and traveling to farms. In urban areas, often in hospitals and clinics or research laborstories.

CAREER INFORMATION-VETERINARIAN

Job Description

A veterinarian works to control and cure diseases and illnesses of animals. Veterinarians will perform surgery on animals, set bones, dress wounds, test and vaccinate animals for disease, and advise owners on the care and breeding of their animals.

Many veterinarians are in private practice and work an average of 50 hours each week. Often these hours are irregular and involve answering emergency calls. In rural areas veterinarians often work outdoors and travel to and from farms. In urban areas most veterinarians work in clean, well lighted hospitals and clinics. Most belong to the American Veterinary Medical Association.

Training

A veterinarian must graduate with a Doctor of Veterinary Medicine from an approved school(college), and pass written and oral examinations to receive a liscense to practice. Civil Service tests are required for those who wish to work in government.

Salary

In 1979 graduates of colleges of veterinary medicine received starting salaries ranging from $16,000-$20,000. Earnings may go as high as $50,000 with several years of experience.

CAREER INFORMATION-MEDICAL TECHNOLOGIST

Job Description

Medical technologists perform scientific, fact-finding tests in laboratories and clinics. Job duties often include obtaining specimens for analysis, identifying microorganisms, cutting, staining and mounting tissue, typing and matching blood samples, and performing other medical research to further control and cure diseases.

Medical technologists may specialize in specific areas, such as blood bank technology, hematology, serology. They may also perform supervisory and administrative duties.

Job Training

Most often graduation from an accredited post secondary program is required for employment as a medical technologist. Requirements will vary with the special area of career interest. In Michigan the Michigan Department of Public Health is responsible for registering and liscensing in this field

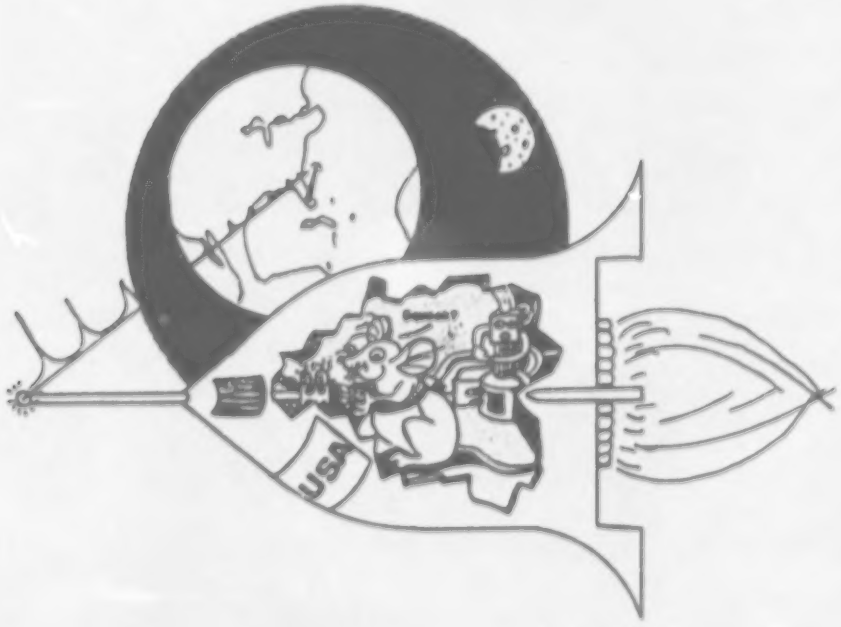
Salary

The salary range for medical technologists is from $10,000-24,300, depending upon experience. The Federal government in 1981 paid starting salaries in this career field of $12,266 or $15,193, depending upon their college records.

Women and Health

Whenever X-ray examinations of the teeth or other parts of the body are made or radiation treatments of any kind are given, some aspects of Dr. Edith Quimby's contributions to the science of radiology are used. In the early twentieth century, physicians became aware of the powerful diagnostic and therapeutic applications of a new tool, radiation, but the tool was in a quite crude form. What treatment should be given to a 170 pound person with a small tumor seven inches below the skin or to a 100 pound person with a large tumor two inches below the skull? Quite simply, the precise radiation treatment was not known. What Edith Quimby did was move the use of radiation from a guessing game to an exact science. Quimby measured how much radiation was emitted from various sources, how much of this radiation was delivered through the air, and how much penetrated through various tissues to different depths. Thus, by applying this information, relatively safe levels of radiation could be used in diagnosis and sufficient, but not too much, radiation could be delivered in therapy.

Laurel van der Wal had several interesting careers, including working on engineering problems of space flight for animals and people. In 1958 during the early days of space flight, she was responsible for Project Mia, in which two mice, Benji and Laska, were sent into space. Van der Wal developed the



equipment necessary for monitoring the mice's heartbeats and telemetering this information back to earth. These and other data gathered by Laurel van der Wal about the physiological effects of space flight guided the succeeding stages of space flight in which dogs and then astronauts were sent up in rockets. (A note about van der Wal's interesting careers which show that people in science careers do not forever and only pursue the work for which they are honored: According to her citation for a Society of Women Engineers award, prior to her work as a space engineer, Laurel van der Wal was a professional model, art instructor, deputy sheriff, gambling casino dealer, and railroad switch tower operator.)

Dr. Estelle Ramey has pursued a rich career in endocrinology, both as a researcher and teacher, and also as a noted speaker, public servant, and leading advocate for women in science careers. Endocrinology is the study of hormones, secretions of the body which are carried in the circulatory system and which regulate the body's physiological processes from the development of secondary sex characteristics in puberty to the maintenance of proper levels of sugar, potassium, and other substances in the blood. One of Dr. Estelle Ramey's early projects was to study the job performed by cortisone and other steroids during stress. A more recent avenue of study has been the question of why men die earlier than women of heart disease (see the mortality table worksheet in Figures Don't Lie for an indication of the differences in life expectancies of men and women). What she and her colleagues have found is that the male hormones increase the incidence of blood clot formation. This effect is not due simply to the presence of the hormone, for indeed females and males both produce both male and female hormones. The problem, rather, seems to result from the relative balance of the male and female hormones. One avenue of countering the tendency to form clots which was investigated in rats was to give additional dosages of female hormones to the males, but this treatment feminized the males without reducing the clotting tendency. Thus, it would appear that the problem is more complex than simply balancing the levels of male and female hormones in the circulatory system; but the solution is not known, and Estelle Ramey and her colleagues continue to study the problem.

CAREER PROGRAM ON SCIENCE:

GRADE FOUR UNIT

Emphasis: Life Science

Career(s): Dentist
Pharmacist

Developers: Joye Bostic
Harold Malone

GRADE FOUR UNIT-OVERVIEW

This unit focuses on two careers: dentist and pharmacist. Approximately two and one-half days are spent in each career field. The unit begins with an invited female pharmacist from a local K-Mart, and a filmstrip for students. The specific information on a career in pharmacy begins the second day. Students use a ditto sheet to reinforce some of the pharmacy vocabulary and conduct an experiment on drug development.

Another scientific experiment on bread mold is begun on the third day. Also on that day a female resource speaker in the dentistry field speaks to the class. A ditto sheet for students is also used, to reinforce the tools of the dentist's trade.

Descriptions, training requirements and salaries in the dental field are provided on the fourth day, and students complete a worksheet on labeling parts of the tooth and improving spatial skills.

The unit concludes with a class project wherein each student checks for food particles in teeth. The pre and post test includes items dealing with both pharmacy and dentistry.

GRADE FOUR UNIT-DAY ONE

Activities

Pre Test

Invite Resource Speaker(suggested: female pharmacist from K-Mart East)

Filmstrip: Pharmacist, National Career Consulting, Inc. available from Jackson ISD, ACFS 13, 65, SF 0231

Teacher Materials

Pre Test ditto sheets

Student Materials

None

GRADE FOUR UNIT-DAY TWO

Activities

Discussion of Pharmacy Career

Scientific Experiment: Drug Development

Pharmacist as a Career: Ditto Sheets for Students

Teacher Materials

"Drug Development" worksheets and materials(see supplemental materials)

"Pharmacist as a Career" ditto sheets

Student Materials

None

GRADE FOUR UNIT-DAY THREE

Activities

Scientific Experiment: Bread Mold

Invite Resource Speaker(suggested reference: Jackson Directory of Nontraditional Workers or Dr. Thompson's dental assistant)

"Dentist and Tools" Ditto Sheet

Teacher Materials

"Dentist and Tools" ditto sheets

Bread Mold materials(see supplemental materials)

Student Materials

None

GRADE FOUR UNIT-DAY FOUR

Activities

Discussion of Dental Careers

Labeling Parts of the Tooth:Student Ditto Sheet

Student Activity: Spatial Skills

Write Thank You Notes to Speaker

Teacher Materials

"Labeling Tooth Parts" ditto sheets

Spatial Skills materials(see supplementary materials)

Student Materials

Pencil and paper for thank you notes

GRADE FOUR UNIT-DAY FIVE

Activities

Class Project: Checking for Food Particles

Post Test

Teacher Materials

Post Test ditto sheets

Food detecting pink pills(available at drug store)

Student Materials

Toothbrush

GRADE FOUR UNIT-SUPPLEMENTAL MATERIALS

The following materials are contained in this section.

The Tools of a Dentist Ditto Sheet

Pharmacy as a Career Ditto Sheet

Drug Development: Student Activity

Bread Mold: Student Activity

Spatial Skills: Student Activity

Pre and Post Test

Labeling Parts of the Tooth Ditto Sheet

Career Information: Dentist

Career Information: Pharmacist

Additional Readings on Women(for teacher use)

"Women and Bones"

"Women and Teeth"

"Women and Drug Development"

THE TOOLS OF A DENTIST

Directions: Unscramble the words in the right column and then draw a line between the two matching words.

1. M I R R O R	1. R E W T A
2. A P P L I A N C E	2. L I D R L
3. C H A I R	3. R R R O M I
4. D R I L L	4. S C A P R E
5. S P A C E R	5. R I C H A
6. R E T A I N E R	6. R R E T I A N E
7. F I L L I N G S	7. S G I N F L L I
8. C A P S	8. S O P E R B
9. P R O B E S	9. C E N P L I A A P
10. W A T E R	10. S C A P

PHARMACY AS A CAREER

Directions: Unscramble the letters in the right column and then draw a line between the two matching words.

1. D R U G S	1. O O F D
2. F O R M U L A S	2. I A T R I C D E P
3. P E D I A T R I C	3. E N I C D E M I
4. M E D I C I N E	4. S G U R G
5. F O O D	5. C O H O L L A
6. A L C O H O L	6. M U L A S F O R
7. P R E S C R I P T I O N	7. P T I O N S P R E S C R I
8. D O S A G E	8. E S N E P S I D
9. D I S P E N S E	9. E A S E I S D
10. D I S E A S E	10. T N E I T A P
11. P A T I E N T	11. A G E D S O
12. L A B O R A T O R Y	12. T R O Y A B L O R A

Activity I: Drug Development

Materials:

- Two jars (such as baby food jars).
- Vegetable oil.
- Liquid soap.
- Water.
- Measuring spoons and cup.

Procedure:

This activity demonstrates how oil is emulsified in water by soap. Analogously, pharmacists who work in drug development try to find emulsifying agents that will keep particular medicines from separating, just as unhomogenized cream separates from the rest of the milk.

Individuals or small groups of students could do this activity or the resource person could demonstrate the process of emulsification. If this activity is done as a demonstration, use more ingredients and larger jars that are more easily seen.

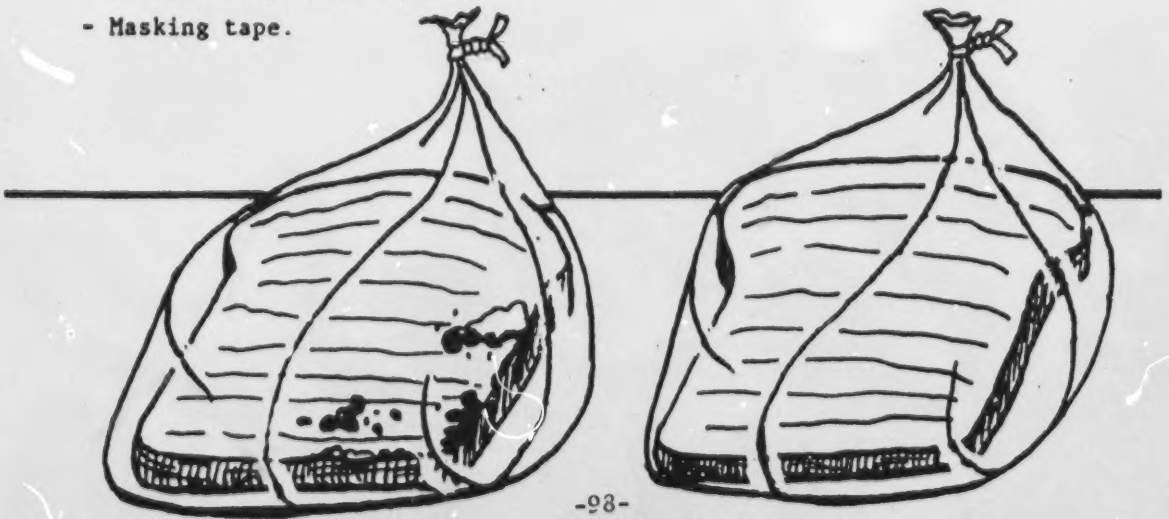
Add a teaspoon of oil to a half cup of water in each of two identical jars. Add one-half teaspoon soap to one of the jars. Tightly cap and vigorously shake both jars. In which jar does the oil separate most rapidly? (Soap is an emulsifying agent.)

At this point the pharmacist could relate this activity to drug development or move on to the extension activity. The work of Seibert, Hazen, and Brown (see "Women and Drug Development") can be mentioned at this point.

Alternate Activity 1: Bread Mold

Materials:

- Baggies or other plastic bags and ties.
- Homemade bread.
- Commercially baked bread.
- Masking tape.



Procedure:

This activity is simpler than the preceding activity but does not include a direct treatment with antiseptic. The antiseptic preservative will already have been included in the commercially baked bread. Because of this activity's simplicity, each student should be able to do this activity. This activity can be started seven to ten days prior to the resource person's visit or be done following the visit.

Place one piece of commercially baked bread in one plastic bag and a piece of homemade (untreated) bread in a second bag. Tie each bag, mark them with a piece of masking tape, and place all of them in a warm location (about 75°F). The bread can be observed daily for the appearance of mold colonies. Blue-green colonies may be a relative of the mold from which penicillin is extracted.

Extension Activity 1: More Spatial Skills

Materials:

- Challenge Cards, one set for each student.

Procedure:

Dentists need to be able to perceive and work with three dimensional objects. For example, they need to shape a filling so it will fit together with the surface of the opposing tooth. The Challenge Cards can be used only to illustrate this skill and not to provide instruction to improve the skill. This activity could be used by the resource person following Activity III or it could be done by the teacher subsequent to the resource person's visit. Distribute the cards separately or together. If students have difficulty, they can cut out paper and make the shapes.

Boxes P, C, and E can be made in the first Challenge Card. B is the box turned so the small rectangle is unseen in the back. E is the box turned over with the triangle underneath.

Cones A and C can be made in the second Challenge Card.

In matching the side and top views in the final Challenge Card, one goes with C, two with A, three with D, and four with B.

GRADE FOUR-PRE AND POST TEST

1. What do you think a pharmacist does?

2. What are the parts of a tooth?

3. How do you feel about a woman pharmacist?

4. Describe three duties of a dentist.

5. Who earns the most?

Pharmacist Dentist

6. Name the two types of pharmacists.

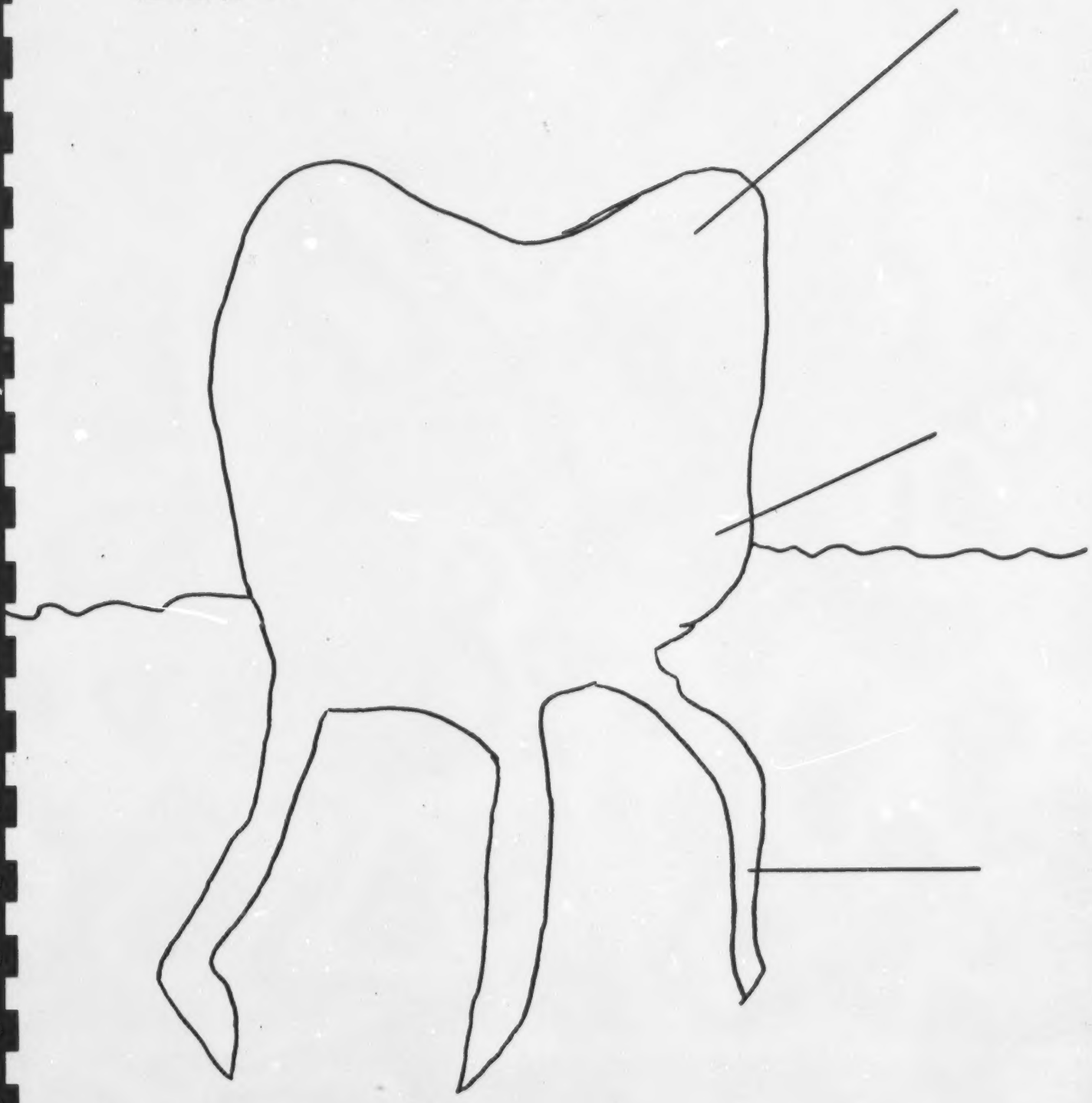
7. What are the tools of a dentist?

8. How often should you visit the dentist?

9. How many women pharmacists work in Jackson?

10. How many women dentists work in the Jackson area?

Label the Parts of a Tooth



Name: _____

CAREER INFORMATION-DENTIST

Job Description

Dentists treat people who have diseases, injuries or malformations of the teeth, gums and mouth. Their job duties include filling teeth, pulling teeth, treating diseased gums, cleaning and straightening teeth, fitting people for dentures(false teeth) and teaching dental care to patients.

Some dentists perform their own laboratory work and use machines such as X-ray machines, drills, surgical instruments and laboratory equipment. Most often they work in clean surroundings and are in private practice. Thus they determine their own working hours. On the average dentists work 40 hours a week. Dentists may specialize in several areas, among them oral surgery, orthodontists(braces), periodontists(gums), and pedodontists(children's dentist)

Training

To enter this field, it is necessary to graduate from an approved school of dentistry, pass oral and written examinations and be licensed from the State. Many college students interested in this field concentrate on biological studies or chemistry.

Salary

Nationally dentists in private practice earned $40,000-$60,000 annually in 1980. Specialists have higher earnings. Dentists beginning in the field averaged $23,566 if employed by a governmental agency.

CAREER INFORMATION-PHARMACY

Job Description

Pharmacists dispense medications prescribed by physicians and other authorized health care practitioners. General duties of a pharmacist include reviewing prescriptions, keeping careful medical records, understanding the use and effect of drugs, ordering and maintaining a supply of drugs, and answering patients' questions about drugs.

Pharmacists may specialize in two areas: community or retail pharmacists, and hospital pharmacists. Generally pharmacists work in clean,pleasant surroundings, such as hospitals, clinics, nursing homes or drug stores. They work an average of 44 hours a week, sometimes on weekends. Most pharmacists belong to professional associations.

Training

To enter a career in pharmacy, all states require a licensed. In Michigan to be licensed, you must graduate from an accredited college of pharmacy and complete at least a 1,000 hour internship program. Each year in Michigan pharmacists must obtain a minimum of 15 hours of continuing education.

Salary

The average salary for a pharmacist was about $24,076 in 1981. Beginning pharmacists averaged $18,000-19,000 annually. Top salary ranges go as high as $30,000-$35,000.

Women and Bones

While veterinarians and physicians mend broken bones, and physical therapists help heal patients with bone problems, anthropologists busy themselves studying bones to learn about the people and animals that produced them. Mary Leakey (see "Women Applying Spatial Relations" in Third Dimension) carefully reconstructed bones from dozens of tiny fragments in order to learn about our prehistoric ancestors. Mildred Trotter, another anthropologist, however, has been more interested in bones of contemporary people.

She extensively studied war casualties and in so doing was able to figure out a way of reliably estimating the overall size of an individual given only the length of the long bones of the arms and legs. The mathematical equation derived by Mildred Trotter is useful not only to academicians interested in estimating the size of people whose skeletal remains were found (say, in a burial mound) but also to forensic scientists interested in determining the identity of a badly decomposed body. Thus, if such remains were found, measurements could be taken of the long bones (femur, humerus, etc., which, of course, remain in tact long after muscles and other tissues decay). These measurements could be plugged into Trotter's equations and the size of the individual determined and joined to other evidence to help identify the body.

Dr. Julie Glowacki has made a very different contribution to our understanding of bones. Working with several surgeons who did the clinical work, Julie Glowacki did the biochemical work which apparently will enable us to grow any needed new bones in the human body. So far, some three dozen people from ages one to 59 have received replacement bones with the most spectacular case being a six year old lad whose badly misshapen skull was reformed into a normal skull.

Heretofore, bone replacement required removal of bone from one part of the body and placement in the new site. This bone graft, if it were not reabsorbed by the body (which happens in one-third to one-half of these operations), would stimulate bone tissue on either side of the bone graft to form new bone tissue. The technique developed by Julie Glowacki and here colleagues does not require the donation of bone from another part of the patient, thus saving one operation. Rather, flakes, chips, or wedges of demineralized bone from a cadaver can be fashioned in place where the new bone is needed. After being put in place, the demineralized bone stimulates the

body to transform this demineralized bone into new bone.

This new technique has several advantages. One, there is virtually no reabsorption of the new bone (as compared to 33 to 50 percent reabsorption in the previous technique). Two, a second operation to acquire the bone graft is not needed, so cost and risk are reduced. Third, almost any donor, including cadavers and probably other animals (this is being worked on), can supply the demineralized bone which can be produced in any necessary form - flakes, chips, or wedges. Fourth, the technique promises to be adaptable to any bone needs; the previous technique was limited. Finally, the demineralized bone technique has a faster recovery rate.

The 206 bones of humans (we have about 300 at birth but this number is reduced as bones fuse together) are made of collagen fibers, water, and calcium, phosphorous, and carbonate salts. In this new process, the mineral fraction of the bone is removed; and when the product is put in place, the body begins to produce cartilage, and finally bone is produced.

The applications of this technique seem limitless, although so far the technique has primarily been used on bones, such as the skull, which do not bear weight. Work on weight-bearing bones in humans has only begun. Relate this work of Dr. Julie Glowacki and her Harvard colleagues and Mildred Trotter in Activities I and II when bone is being studied.

R

Women and Teeth

Two diseases affecting the teeth, dental caries (cavities) and periodontal disease, are among the most prevalent of human afflictions. Despite the widespread evidence of the salubrious effect of good nutrition and proper personal oral hygiene, dental caries affects 90 percent of the world's population and another 70 percent are affected by periodontal disease. Because these and other malnutrition diseases manifest themselves in the oral cavity and because patients, on the average, are seen more frequently by dentists than by physicians, dentists and dental hygienists are in a particularly good position to spot malnutrition and advise patients on corrective and preventative measures.

Dr. Patricia Randolph has studied these problems and written extensively for both professionals and the public (see, for example, Diet, Nutrition and Dentistry by Randolph and Dennison. St. Louis: C.V. Mosby. 1980). Patricia Randolph's work exemplifies one of science's important functions, the instruction of the general public on research results as these findings affect the daily lives of people. Pat Randolph is "into" teeth.

The causes of cavities are numerous, but clearly the immediate cause of cavities is the action of acid to demineralize teeth. This acid is a by-product of bacteria living in the plaque, a gelatinous material which adheres to the teeth unless removed by proper brushing and flossing. When sugar-containing food is eaten, the bacteria immediately begin to consume it, lowering the pH (acidity) of the plaque to 5.5, a low enough pH to produce demineralization. This lowering of the pH continues for 20 to 30 minutes following the sugar's ingestion.

The detrimental bacterial action is not simply a function of the amount of sugar-containing foods consumed, since the harmful acidic product is active for only 20 to 30 minutes. If sugar intake is limited to mealtime, then the effect of acid can be confined. However, Randolph cautions, if sugar is consumed throughout the day (as in between meal snacks), then the bacterial

Women and Drug Development

We like to think that tuberculosis has been eradicated. However, in 1978 TB struck three million people worldwide, including 29,000 Americans. In 1977 TB caused 3,000 deaths in the United States. The front line defense against tuberculosis remains the tuberculin skin test. People who have had or currently have an active tuberculosis infection produce a reaction to the tuberculin. Once identified, these people can receive medical treatment.

The currently used form of tuberculin, called PPD (Purified Protein Derivative), was developed in the mid-1930's by Dr. Florence B. Seibert. Tuberculin had been available since the 1890's when Koch initially developed the test, but the tuberculin produced by the Koch method did not produce reliable results. Sometimes a positive result was obtained in a person who did not have the disease. That was a big enough problem, but an even bigger problem arose because some cases were overlooked due to a false negative test.

The Koch tuberculin produced unreliable results, because the Koch method, salutary as it was, produced an inconsistent product. Florence Seibert, working on a team with support from the National Tuberculosis Association (who provide Christmas Seals), was able to produce tuberculin in a new way. Her technique consistently produced the same product, and this tuberculin consistently produced reliable results.

While Florence Seibert developed a technique to produce a drug for disease testing, Dr. Rachel Fuller Brown and Dr. Elizabeth Hazen developed a drug which combated disease. Nystatin, which is dispensed in several forms, combats fungal infection, which is more prevalent than often believed. Fungal infection accounted for 40% of hospital cases among American troops in Vietnam and nearly 80% of outpatient visits.

The warm, moist conditions prevalent in Vietnam encouraged fungal infections, but those diseases are not limited to tropical areas. Ringworm, which in one form is better known as athlete's foot but which definitely is not limited to the foot, is not a worm, but rather a fungal infection. The ring-shaped growth pattern, which gives ringworm its name, results from its being caused by a fungus; and we are familiar with the round shape of mold growths on bread, fruit, and cheese.

In addition to treatment of fungal infections of the skin, nystatin is

Teacher's Notes

CAREER PROGRAM ON SCIENCE:

GRADE FIVE UNIT

Emphasis: Math/Technical Science

Career(s): Computer Programmer

Developers: Samella Kendrick
Willye Pigott

GRADE FIVE UNIT-OVERVIEW

This unit for fifth grades focuses on the math/technical field of science, with a special emphasis on the computer programmer. The unit begins with a female computer engineer speaking to the class and providing basic information on this career field. The vocabulary of this career field is introduced on the second day, along with a filmstrip. On the third day students create a "computer" out of an old shoebox and make key punch cards which are "stored" in their computers. A field trip to a local place of business or industry where computer operations are central to that business is the highlight of the fourth day in this unit. The unit is concluded on the fifth day with a class presentation of the computer and key punch cards which each student has made.

The pre and post test has been designed primarily to test the vocabulary of the math and technical fields of science. Students introduced to this unit in fifth grade should feel "comfortable" with the introduction of the sixth grade unit on the systems analyst. The sixth grade unit further reinforces skills in sorting and identifying information which is taught in the students' class project of making key punch cards and storing information in a self-made computer.

GRADE FIVE UNIT-DAY ONE

Activities

Pre Test

Invite Resource Person(suggested: Undrula White, computer engineer at Gilbert Commonwealth in Jackson)

Teacher Materials

Pre Test ditto sheets

Student Materials

None

NOTES

GRADE FIVE UNIT-DAY TWO

Activities

Vocabulary Definitions and Discussion

Filmstrip(suggested: The Fascinating World of Computer Programming, available by contacting REMC)

Teacher Materials

Filmstrip and audio visual equipment

Vocabulary List ditto sheets

Student Materials

None

GRADE FIVE UNIT-DAY THREE

Activities

Creating a Computer: Student Activity

Sorting Information: Student Activity

Teacher Materials

Hole puncher, 3x5 cards (also see supplemental materials)

Student Materials

Shoebox from home (or other small box)

GRADE FIVE UNIT-DAY FOUR

Activities

Field Trip(suggested: data processing company or place of business of the resource speaker)

Teacher Materials

None

Student Materials

Permission slip(if necessary)

GRADE FIVE UNIT-DAY FIVE

Activities

Post Test

Class Presentation: Student Computers

Teacher Materials

Post Test ditto sheets

Student Materials

Computer cards and computer "boxes" (see Day Three activities)

GRADE FIVE UNIT-SUPPLEMENTAL MATERIALS

The following materials are contained in this section:

Vocabulary List

Activity: Sorting Information

Pre and Post Test

Pre and Post Test Key

Career Information: Computer Programmer

Additional Readings on Women(for teacher use)

"Women and Computers"

VOCABULARY LIST

1. data processing
2. computer
3. input
4. computer programmer
5. calculations
6. control console
7. analyst
8. essential
9. industry
10. formula
11. technician
12. mathematician
13. statistics
14. engineer
15. theory
16. electronics
17. research
18. career
19. analyze
20. scientific
21. microcomputer

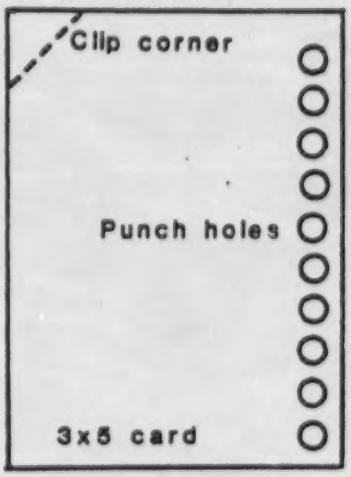
Activity 2: Sorting Information

Materials:

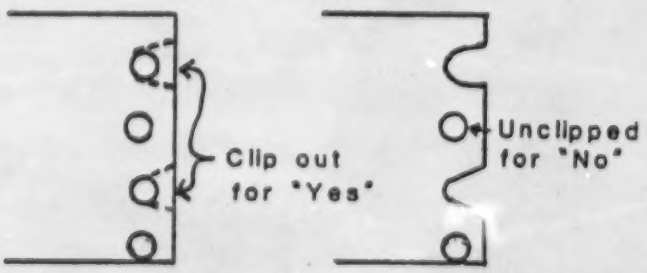
- For each student a 3" x 5" or similar card with holes evenly spaced and punched along a long edge (punched with a hole punch) and one corner clipped.
- For each 4-6 students a paper clip straightened out.

Procedure:

Students should have completed Activity I or other activities dealing with binary classification before doing this activity. The punched and clipped cards should be prepared before class to save the resource person's time To further save the resource person's time, this activity could be done prior to the visit; and the resource person could begin by relating this activity to their career.



Tell students that the sorting and identification of objects in Activity I can be done in a more mechanical fashion through the use of cards and a wire. Draw a card on the blackboard and show how information about an object in the form of a series of yes-no questions could be stored on cards. As an example, show students how the chart used to sort eight people in Activity I could be put on the card as a series of yes-no questions. Eight cards, one for each person, would have to be prepared; but for each person (card), each hole would have to contain the information for the same question. Hole one could contain the answer to the question, "Is this person a research scientist?" On the board write this question next to hole one. If the answer to the question is yes for the person (card), the space between hole one and the edge of the card could be clipped out, as is shown in the illustration. If the answer to that questions were no for the person (card), the edge of the

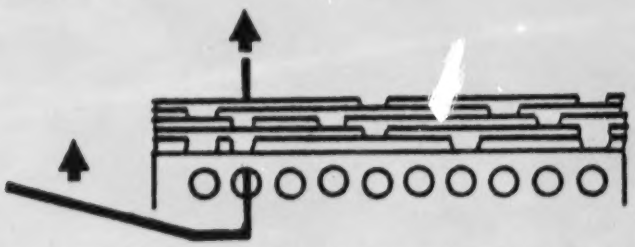


card next to hole one would not be clipped. On the board write, "Yes = Clip. No = No clip." If you were preparing cards for Rosalind Yalow, Robert Watson, Louis Leakey, and Jane Goodall, hole one would be clipped on all four cards, since each of these people is a research scientist. Hole one for the other four people (cards) would not be clipped.

Hole two could be used for the question, "Is this person an architect?" Only cards for Julia Morgan and I.M. Pei would be clipped; the other six cards would not be clipped next to hole two. Point out that for each card each hole has to be clipped or not clipped. Even if the question on the chart did not affect one or more of the people, the answer to the question must be stored in the card.

Point out to students that in this example six more holes (questions) would have to be designated. Hole three could represent the question, "Did this person land on the moon?," and so forth.

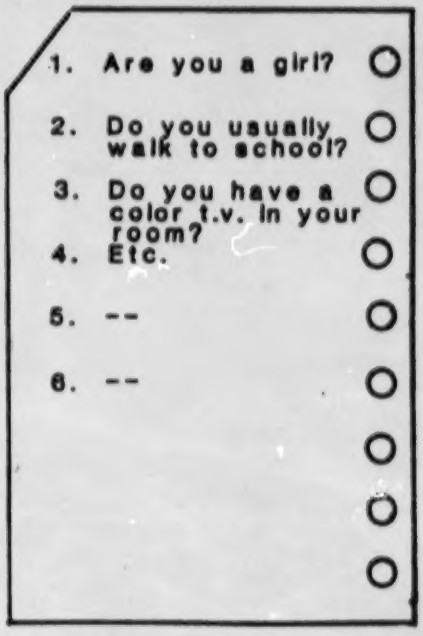
After the information (i.e., the answers to each question for each person) has been stored on the cards using this system of clipping or not clipping, the information can be retrieved with the use of a wire (bent out paper clip). Let's say you are interested in finding out who among the eight people is an architect. The answer to that question has been stored in hole two, so the cards would be stacked up (being careful to keep the clipped corner of each card in the same location so that hole two for each card falls on top of hole two for the other cards) and the wire would be placed through hole two. While loosely holding the cards in one hand, the wire should be pulled up. The wire will bring with it all cards for people who are not architects (remember, their hole two wasn't clipped); and the people who are architects will remain behind (because their hole two was clipped and the wire won't catch their cards).



In similar fashion one could ask a series of questions. For example, who among this group (if anyone) was an architect and research scientist? By successively placing the wire through the two holes associated with these two

questions, any person with these two characteristics can be found. (In this case, none of the eight has these two characteristics.)

Having illustrated this sorting process, the resource person or teacher can lead students in an application of the sorting process to their classroom. Give each student a punched card with the corner clipped off. Each student should put their name on the top of the card. Students can suggest yes-no questions they would like answered about the class and these questions can be assigned to holes for the entire class, as is shown in the illustration. Students should copy the questions in the proper place on the cards; and they should clip or not clip the associated hole according to how they answer the questions themselves.



Cards can be sorted in various ways. For example, referring to the illustration, the wire could be placed through hole one in the stack of cards, and all the girls' cards would fall off the wire and the boys' cards would be caught by the wire.

Following this activity, the resource person should be able to relate this card sort to the computer in one of two ways. First, one application of computers is keeping track of information. For example, a business may be interested in searching through its files to find former customers who would be good potential customers for a new product. The business could sort their customers into two groups, good and poor prospects, much as students sorted the cards. A second application of this activity is its illustration of how information is stored and read by a computer. Whether the information is stored on a card, tape, or disc, the information is stored at specific locations determined by the computer program (just as certain questions were assigned specific holes on the card). Also, the information is stored for the computer as a series of punched or not punched holes (or magnetised or unmagnetised spots) just as the information was stored on student cards as clipped or not clipped holes.

GRADE FIVE UNIT-PRE AND POST TEST

1. _____ _____ have greatly changed everyday lives and the worlds of business, science and government.

2. Computers perform the most complicated _____ calculations instantly.

3. Most computers are the _____ unit of a _____ _____ system.

4. Data entered into the computer comes from _____, _____, _____, _____, _____, and _____.

5. _____ _____ plan and organize the procedure a computer will follow to carry out a job.

6. Computer operations and other technologies create demands for people who understand _____.

7. _____ is the science of numbers.

8. The work of a programmer usually has _____ steps.

9.

9. A _____ _____ may head the program and direct other programmers.

10. _____ _____ write only specific parts of broad programs.

GRADE FIVE-PRE AND POST TEST KEY

1. electronic computers

2. mathematical

3. central data

4. punched cards, punched paper type, typewriters, magnetic tape, video terminal devices and discs

5. computer programmers

6. math

7. mathematics

8. five

9. chief programmer

10. beginning programmer

CAREER INFORMATION-COMPUTER PROGRAMMER

Job Description

Computer programmers write step-by-step instructionf for computers. These instructions tell the computer exactly what it must do to solve a problem or perform a certain task. The general duties of a computer programmer include writing out the steps in the form of a flow chart, writing steps in computer language, modifying programs to meet new requirements for problem-solving, and operating the computers. Most often computer programmers work closely with systems analysts (see Grade Six Unit for more information on systems analysis).

Most often computer programmers work under the direction of a supervisor. They work 8 hours a day, usually five days a week. Evening or weekend work is sometimes required, as is overtime time if a project must be completed.

Training

There are approved programs in high school vocational programs that will prepare the student to enter this career field. College desgrees are not always required for job entry, though employers often prefer candidates with some post secondary training.

Salary

Salaries for computer programmers range from $7,000-$35,000, depending upon experience and the type of programming involved. Computer program managers earned $24,400-$53,100 in 1980.

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Women and Computers

In the mid-nineteenth century, Charles Babbage developed what is generally credited to be the first computer, even though his machine was never quite finished and that machine (with no electricity involved) is a far cry from contemporary computers. While Babbage pointed the way to computers, his colleague, Ada Byron Lovelace, is generally credited with being the first computer programmer. Her writings transformed Babbage's nearly incomprehensible ideas into a form more understandable to the public; and, more importantly, she provided the first clear instructions for how to program the computer. In essence, she said, "Here's what this machine can do and here's how you can make it work."

Following Babbage's only partial success with a mechanical computer, computer development languished for nearly a century. Then, during and immediately following World War II, the Mark I, II, and III computers, which were partially mechanical and partially electrical, were developed. Grace Hopper, a WAVE Lieutenant assigned to the Navy's Bureau of Ordinance Computation at Harvard and later a Harvard professor, developed the concept of automatic programming while working with these computers. That is, she developed the idea of the computer receiving instruction in a language somewhat similar to the everyday language of the person doing the programming and translating that language into a form with which the computer could work. Whereas prior to Grace Hopper's work, a programmer had to know how to communicate directly in "computer language" in order to instruct and understand the computer, now one could instruct the computer in a more natural sounding language. In short, she opened up computing to much more of the general public.

How could this be? What is so significant about what she did? To begin with, computers can work only in Base 2. Thus, whatever number is fed to a computer, the number first must be translated into Base 2; and when the computer provides numbers to the user, the reverse translation has to take place. The number 3 in Base 10 becomes 11 in Base 2, 4 becomes 100, 5 becomes 101, 6 becomes 110, and so forth. That number translation is not too difficult to master, but it alone can be a very tedious process. However, all communications with computers, not just numbers, must be translated into Base 2. Thus,

X

translation is required for letters (A, B, C . . .), symbols (+, -, x, etc.), and commands, such as "move this number from here and store it there in the computer." To do a very simple process, such as "add a to b," requires lines of instruction to the computer in computer language. What Grace Hopper did was enable the programmer to simply instruct the computer to add a to b and force the computer to automatically translate that statement into a form with which the computer could work. She gave the computer a built-in translater.

Grace Hopper's particular work led to the language called COBOL which is widely used in business applications. However, a host of other languages such as FORTRAN, BASIC, PASCAL, and now ADA (in honor of Ada Lovelace) exist, just as a variety of human languages (Chinese, Italian, Swahili, and so forth) exist. Each language has its own best sphere of application, say in science, instruction, or artificial intelligence.

As you show students how to use BASIC in Activities II and III, relate to them the parts Ada Byron Lovelace and Grace Hopper played in the development of computer programming. If they ever become discouraged about programming, remind them that were it not for Grace Hopper, almost none of them would ever begin to use a computer.

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```
32 PRINT "DO YOU WISH TO DO ANOTHER PROBLEM?"
34 PRINT "TYPE 1 FOR YES OR 2 FOR NO"
36 INPUT T
38 IF T = 1 THEN 10
39 GO TO 50
RUN
```

Many other programs could be written to allow data to be put into a program to allow it to be flexible. The resource person could demonstrate additional applications of the INPUT command.

Career Information

Well over a million people are employed in various levels of computing, and many more people use computers in some aspect of their work. There are 660,000 computer operating personnel (including keypunch operators, data typists, and console operators), 247,000 computer programmers, and 182,000 systems analysts.

Systems analysts are the problem solvers of computing. They gather information about the problem needing solution and then outline a solution, much like the flow charts found in Activity I. They may work in manufacturing, banks, insurance, education, and so forth, or for a data processing service bureau which provides computing services to various customers. Systems analysts need a college education with major work in computing. In addition, they should have continual advanced training, because of the constant changes occurring in computing, plus training and/or experience in the area of problems being solved.

Once a problem solution has been developed by the systems analyst, the computer programmer translates the solution into a program which directs the computer to carry out the solution. A programmer may work only in a relatively simple language, such as BASIC which is used in Activities II and III, or in both the simple languages and the language which the computer can use without an intermediary translation step. The requirements for entry into computer programming are quite varied depending on the level of programming to be done. However, programmers increasingly have completed college with majors in computing plus experience and/or training in the area where they write programs.

The primary jobs of computer operating personnel are to enter programs and data into a computer and operate the computer to make it execute programs. These people usually must be high school graduates and have received training at a vocational or community college, in the military, or on the job.

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Related Activities:

Lewis, Bruce. Meet the Computer. New York: Dodd, Mead. 1977.

Sources of Additional Information:

Computing is an especially rapidly developing field. Therefore, magazines are a better source then books for keeping up on developments. Here are some of the current magazines.

Classroom Computer Notes, P.O. Box 266, Cambridge, Massachusetts 02138.

Creative Computing, P.O. Box 789-M, Morriston, New Jersey 07960.

Electronic Learning, Scholastic, Inc., 50 West 44th St., New York, New York 10036.

Mathematics Teacher and Arithmetic Teacher, National Council of Teachers of Mathematics, 1906 Association Drive, Reston, Virginia 22091. (Some articles or issues devoted to computing.)

On Computing, 70 Main Street, Peterborough, New Hampshire 03458.

Recreational Computing, P.O. Box E, Menlo Park, California 94025.

The Computing Teacher, Computing Center, Eastern Oregon State College, La Grande, Oregon 97850.

COMETS Profiles:

Sally Sedelow: Professor of Computer Science and of Linguistics. Can Shakespeare be analyzed by computer? Yes, by Sally Sedelow, who has wedded her three degrees in English Literature to computer analysis.

For More Career Information Write:

American Federation of Information Processing Societies, 1815 N. Lynn Street, Arlington, Virginia 22209.

CAREER PROGRAM ON SCIENCE:

GRADE SIX UNIT

Emphasis: Life/Technical Science

Career(s); Systems Analyst

Developers: Sheryl Fagin-Hutchings
Marilyn Rossman

GRADE SIX UNIT-OVERVIEW

This unit focuses on the career of Systems Analyst. The unit begins with a hands-on experience for students who are encouraged to bring in computers, calculators and electronic games from home. The idea is introduced that these instruments are instruments that assist people in problem solving. The description, training and salary information is presented on the first day for this career field.

Students are introduced to the concept of sorting information on the second day. Sorting information worksheets are practiced in class, then sent home with students for homework. The family should be encouraged to help the student with the homework sheets.

The concept of flow charts in introduced on the third day, with overhead and blackboard examples used frequently to teach the concept of charting. Students make a flow chart in class(suggested idea: a flow chart of daily activities), following practice in class.

Students are challenged on the fourth day to create their own sorting identity sheets, similar to those used in the homework assignment. These sheets are collected in a class booklet which is presented/shown to the female guest speaker on the last day of the unit.

GRADE SIX UNIT-DAY ONE

Activities

Pre Test

Hands-On with Computers (Suggested: students bring any type of computer game or calculator to class on the first day of this unit)

Introduction of the Career: Systems Analyst

Teacher Materials

Pre Test ditto sheets

Student Materials

Electronic game, calculator, etc.

GRADE SIX UNIT-DAY TWO

Activities

Introduce the Concept of Sorting

Student Activity: Sorting Worksheets

Teacher Materials

Examples for blackboard or overhead (see supplemental materials)

Sorting Worksheets (see supplemental materials)

Student Materials

Sorting Worksheets (homework assignment)

GRADE SIX UNIT-DAY THREE

Activities

Introduce Flow Chart Concept

Sequencing Ideas: Student Activity

Teacher Materials

Flow chart examples for blackboard (see supplemental materials)

Overhead projector

Sequencing Ideas activity sheets for students

Student Materials

None

GRADE SIX UNIT-DAY FOUR

Activities

Class Project: Making Flow Charts

Teacher Materials

Sequencing Ideas activity sheet(for review)

Student Materials

Scissors

Paste

Paper

Newspapers

Magazines

GRADE SIX UNIT-DAY FIVE

Activities

Invite Resource Speaker (female)

Class Presentation of Flow Charts (all charts collected together in one "book" to conclude this class project)

Post Test

Teacher Materials

Post Test ditto sheets

Student Materials

Completed flow charts (from Day Four activity)

SIXTH GRADE UNIT-SUPPLEMENTAL MATERIALS

The following materials are included in this section:

Sequencing Ideas Worksheet

Sorting Ideas Worksheets(3)

Sorting Ideas Worksheet Information and Code

Flow Chart Activity

Pre and Post Test

Pre and Post Test Key

Career Information: Systems Analyst

Sorting Information Notes for the Teacher

Additional Readings on Women(for teacher use)

"Women and Mathematics"

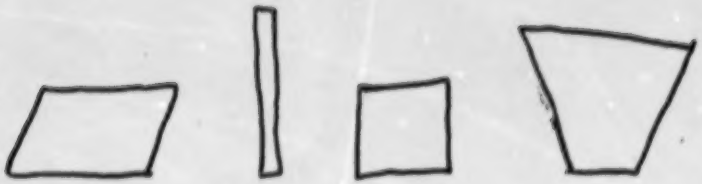
SEQUENCING IDEAS WORKSHEET

Directions: In the left column several ideas are listed. These ideas include many things that you do while you are at school. However, these ideas are not in order. Write these ideas in order in the right column.

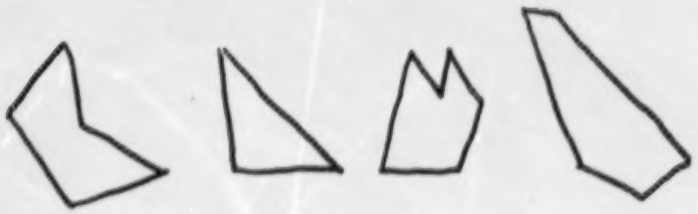
Eat lunch	_____
Get off school bus and go into school	_____
Get on school bus to return home	_____
Hand in homework in first hour class	_____
Put your coat in your locker	_____
Go to fourth hour gym class	_____
Visit the library during second hour class period	_____

SORTING INFORMATION WORKSHEET

All of these are quads.



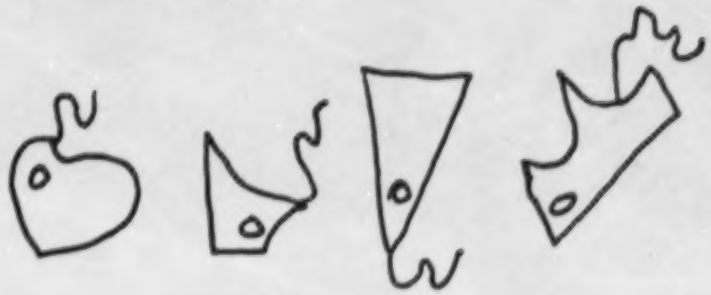
None of these are quads.



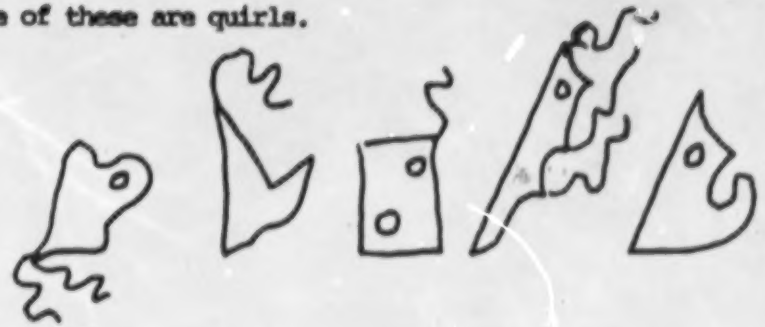
Which of these are quads?

144

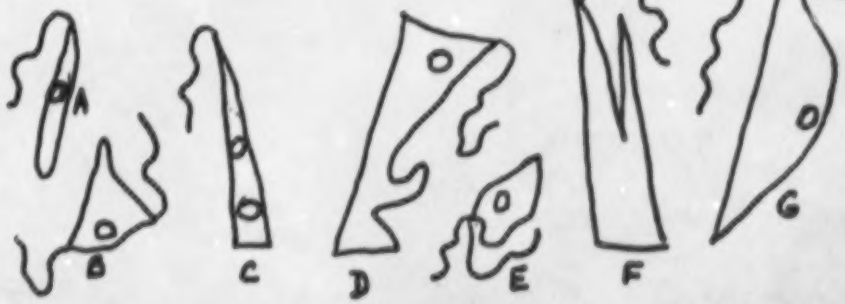
All of these are quirls.



None of these are quirls.



Which are these are quirls?

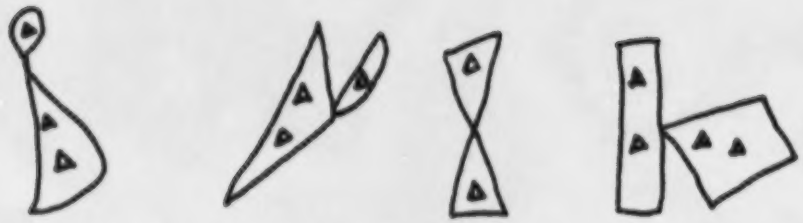


145

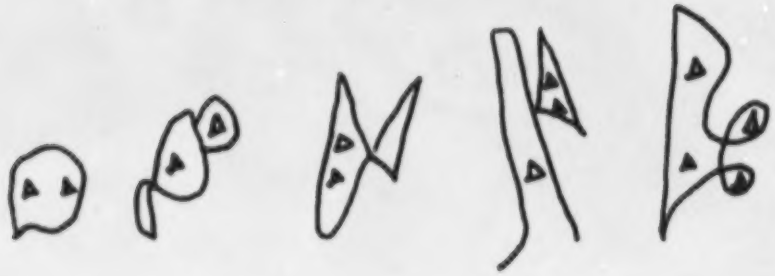
139

SORTING INFORMATION WORKSHEET

All of these are selts.



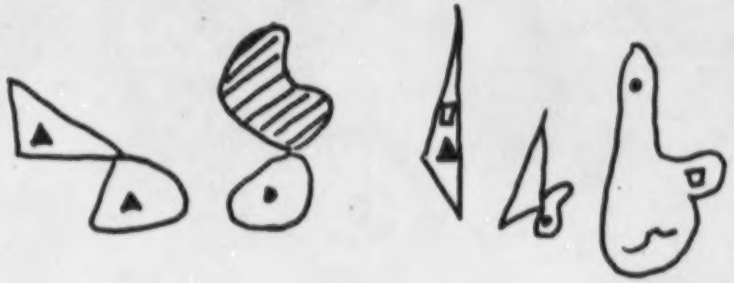
None of these are selts.



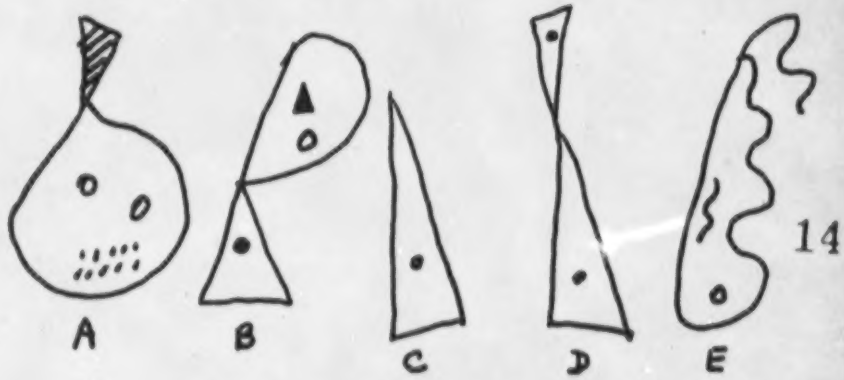
Which of these are selts?

All of these are whododdles.

None of these are whododdles.

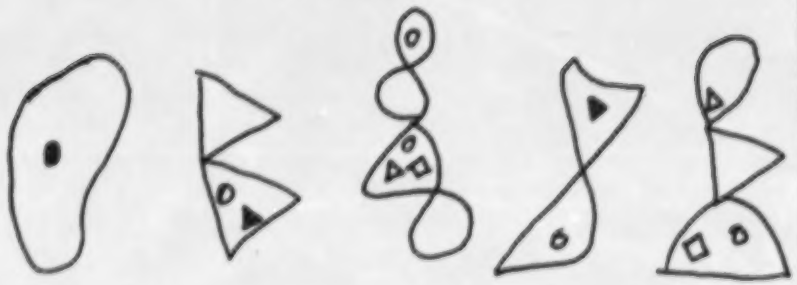


Which of these are whododdles?

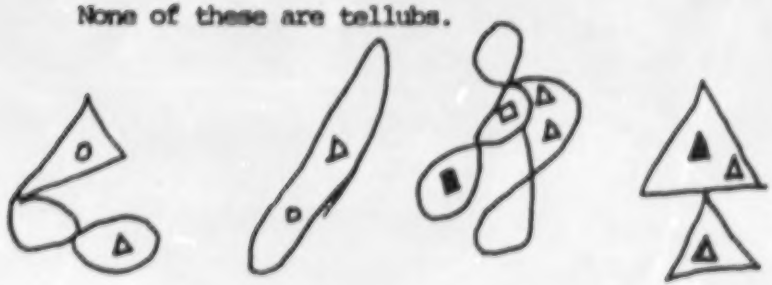


SORTING INFORMATION WORKSHEET

All of these are tellubs.

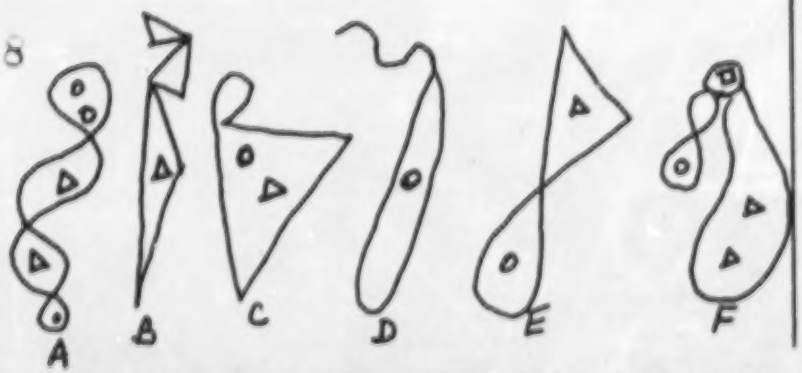


None of these are tellubs.



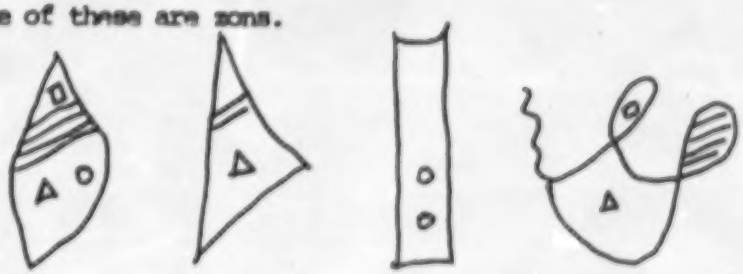
Which of these are tellubs.

148



All of these are zons.

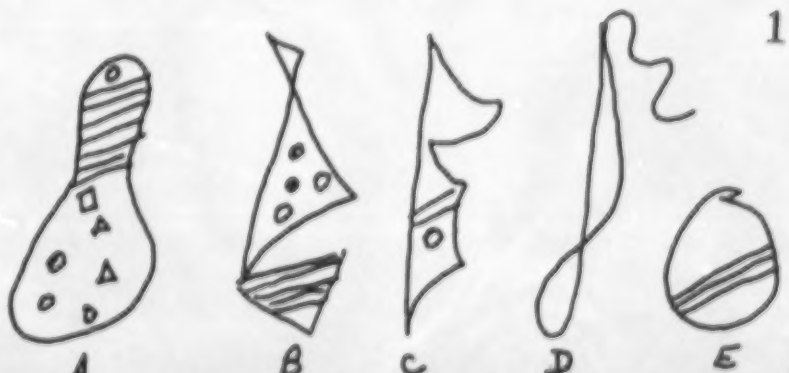
None of these are zons.



141

Which of these are zons?

149



WORKSHEET INFORMATION AND CODE

Characteristics	Code
Quads have four sides.	A-D-E
Quirls have one tail attached and one small circle inside.	A-D-G
Selts have two closed shapes with at least one small triangle inside each closed shape.	B-F
Whododdles contain a small black circle inside any triangle making up each figure.	B-C-D
Tellubes have the same number of small shapes(circles, triangles, or squares) somewhere inside the whole figure as there are closed shapes(curves making up the figure)	C-D-E-F
Zons have as many lines of "shading" as small objects in the entire figure. Note: D has zero lines of shading and zero small objects in it)	A-B-D

X

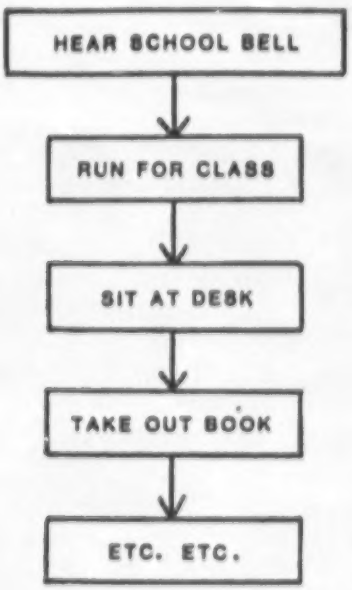
Activity I: Flow Charts

Materials:

- One copy of Flow Chart Worksheet per student.

Background Information:

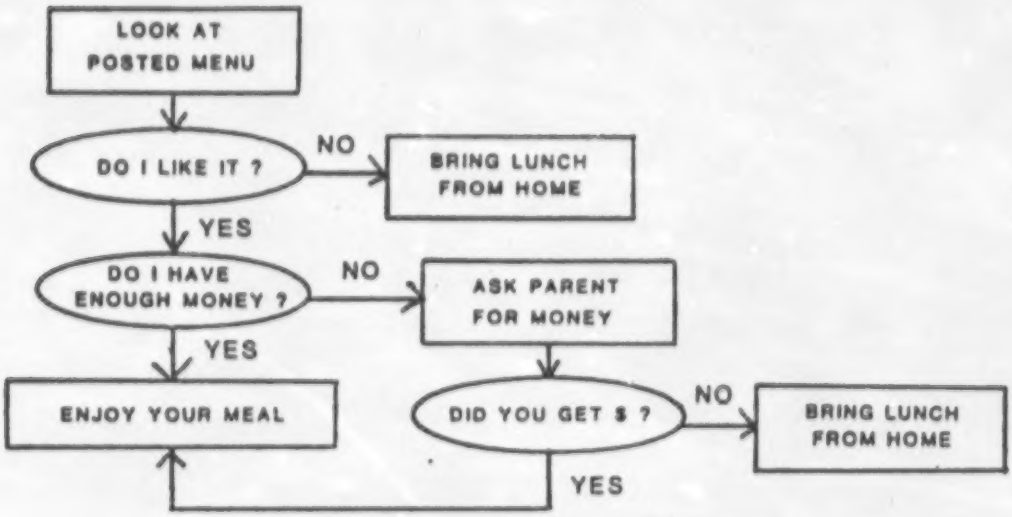
Computers solve problems, but first the computer must be instructed about how to solve the problems. The instructions to the computer are contained in "programs." However, prior to writing a computer program, the programmer or systems analyst must figure out a "flow chart," which is a step-by-step procedure for solving the problem. Some flow charts are linear, that is, they move without variation from one step to the next. Here's a flow chart which shows a procedure frequently followed by students. The boxes indicate "commands," which in this case are directed to the student; but in a computer flow chart, the commands would be directed at the computer.



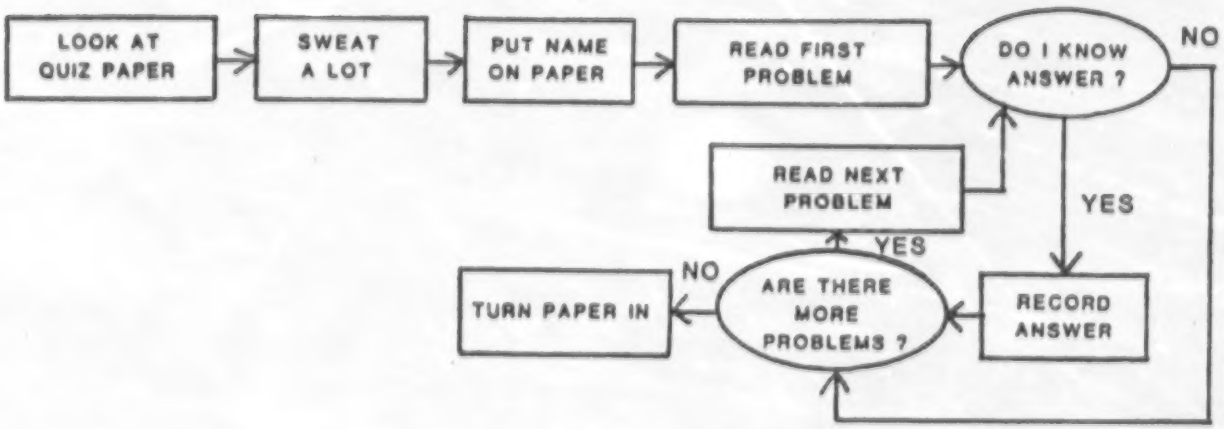
Since linear flow charts allow for no deviation in the order in which commands are given, they have limited use. To allow for variation in the order of commands, a branching flow chart is drawn. Embedded in a branching flow chart are yes-no questions (shown by ovals in the chart). If the answer to the question is yes, the flow chart branches in a different direction leading to different commands. Here's an example of a branching flow chart.

Possible Flow Charts:

LUNCH



QUIZ



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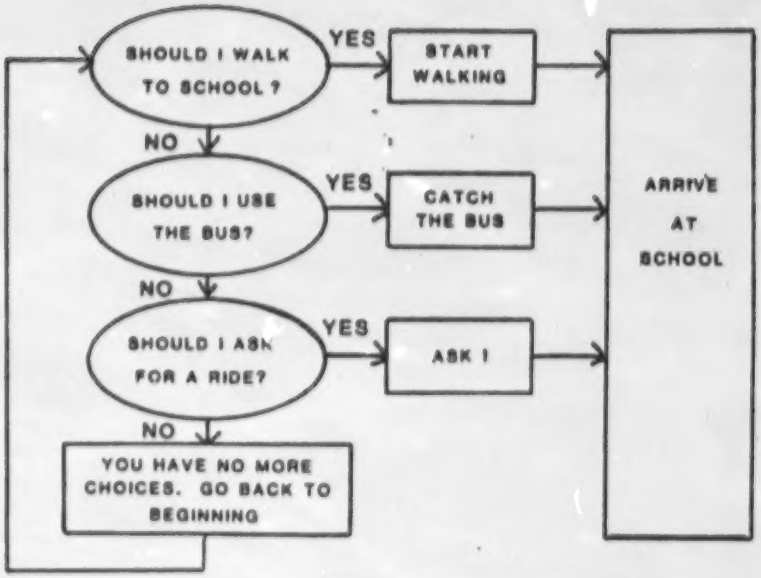


Procedure:

The resource person should briefly give students some information about flow charts and their purposes similar to the background information provided here. The sample flow charts for linear and branching programs can be drawn on the blackboard or reproduced on an overhead projector. Next, distribute the Flow Chart Worksheet to students and have them orally describe the flow chart to make certain they understand the directions summarized in the flow chart. Finally, have students write a flow chart for each of these problems which are also asked on the worksheet.

- Flow chart for deciding whether to eat school lunch or to bring lunch from home.
- Flow chart for taking a surprise quiz.

The resource person may choose to have students work as a group on one problem while putting their suggested flow chart on the blackboard. Here are possible flow charts for each of these problems. After completing these problems, the resource people should move on to relating the use of flow charts in their computing.

GRADE SIX UNIT-PRE AND POST TEST

1. What is a Systems Analyst?

2. What problems are faced by a Systems Analyst?

3. What tool is used by a Systems Analyst?

4. How much does a Systems Analyst earn?

5. Only women can become a Systems Analyst.

   True False

6. What school subjects are most important for preparing to be a Systems Analyst?

GRADE SIX UNIT-PRE AND POST TEST KEY

1. A Systems Analyst is a person who uses computers to help solve problems.

2. Problems include sorting and/or classifying information.

3. Computers

4. $15,000-$38,000

5. False

6. Important school subjects include math computations and problem solving classes, as well as oral and written language skills(reading).

CAREER INFORMATION-SYSTEMS ANALYST

Job Description

A systems analyst is a person trained to use computers to solve problems. The general duties of a systems analyst include meeting with engineers, scientists or management to define problems that need to be solved, gathering information and preparing flow charts from this information, working with computer programmers to write a program to solve the problem, and interpreting the computer information in nontechnical language. Much of the work of a systems analyst is done independently, though sometimes they work in teams to solve problems. Most often they work 40 hours each week, though sometimes must work on weekends and evenings to complete a problem-solving project.

Training

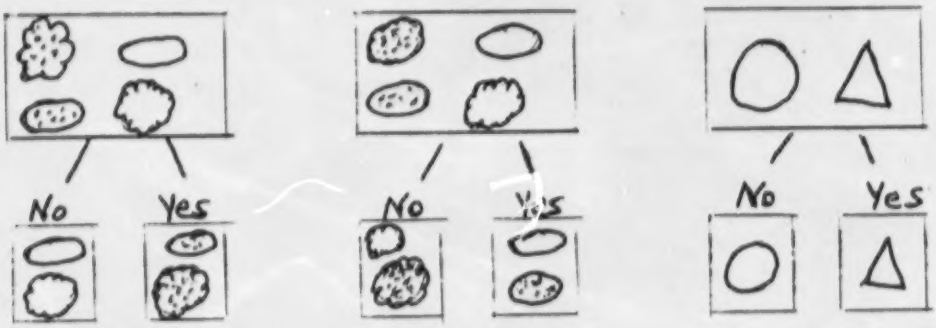
Most employers require at least a bachelor's degree in a computer-related field of study. All branches of the military provide training in this area, as do many community colleges.

Salary

In 1982 systems analysts with two years of job experience earned $17,000-$34,900 annually. Systems analysts managers' earnings ranged from $24,400-$53,000, depending upon experience and the problem-solving projects involved. Beginning salaries in this field ranged from $16,560-$22,584 in 1981.

SORTING INFORMATION NOTES FOR THE TEACHER

Begin by pointing out to students that they consciously or unconsciously name objects all the time. In essence they are classifying or sorting information. Proceed to tell the students that the systems analyst often does <u>not</u> have a ready-made system for sorting objects. A sorting procedure has to be devised. For example, these four objects would be classified into objects with spots and objects lacking spots. However, they could just as well be sorted into objects with straight sides or objects with oval shapes.



SPOTS? OVAL SHAPES? STRAIGHT LINES?

Use these examples and others from the Sorting Information Worksheets on the blackboard or overhead to make certain students understand the concepts of sorting information before the homework assignment is given.

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Women and Mathematics

Gabrielle-Emilie Le Tonnelier de Breteuil, Marquise du Chatelet-Lomont, born in 1706 in France, could have lived a frivolous life befitting the aristocratic status her name implies. Better known as Emilie du Chatelet, she did indeed enjoy luxuries unavailable to nearly all other French people; but she also acquired an education, unusual for a woman even of her rank, pursued an intimate relationship with Voltaire, and made available to Enlightenment France the Principia of Newton.

The new understanding of the scientific method revealed through Emilie du Chatelet's translation and analysis of the Principia influenced both physical and social science. Chatelet's intellectual peers reasoned that just as mechanical laws had been uncovered in the physical realm, so also mechancial laws could be discovered in the social realm. Once the laws had been revealed, they could be applied to improving the lot of everyone. For example, by varying the amount of education available to a child, that child s adult economic status might be affected. In order to more clearly show how physical laws were to be applied to social laws, this example might be restated, "Adult economic status, AES, is a function of a child's education, CD." Or, AES = $\int$ CE, (the symbol, $\int$, means "is a function of.")

More and more early adolescent students are aware of functions because their textbooks have introduced the idea of a "function machine." A function machine has three parts: (1) input (the numbers or symbols fed into the machine), (2) output (the numbers or symbols produced by the machine), and (3) the function rule (the arithematic or other type of directions for how to change the input into output). For example, the function rule could be "square the input." Then, for an input of 3, the output would be 9. Given two of the three parts of the function machine, the missing part can be derived.

Function machines are not limited to raw number inputs and outputs; the machine can also work on variables. Suppose the input was the variable, "height from which an object is dropped," and the output was the variable, "speed of the object at any point in time." As most of us know from experience, as the object falls it picks up speed - it goes faster and faster. Its speed is constantly changing; so it is difficult - if not impossible - to calculate the object's speed at any single point in time. How can you put a

precise figure (say, 31.2 miles per hour) on something that is always changing?

In order to solve this kind of problem, a new mathematics had to be invented; and that's what Newton did. He invented calculus; because he needed it in order to work out the mechanical problems that he was studying.

Emilie du Chatelet did not invent calculus. What she did do, however, was translate Newton's version into French and added notes of explanation which opened up this powerful new mathematical tool to the Enlightenment philosophers on the continent. (To this day, her translation remains the only French version of the Principia.) Also, we cannot say that Emilie du Chatelet caused the French Revolution and the American Revolution; however, we can note first, the powerful influence of Enlightenment thought on both those events, and second, the importance of Chatelet's version of Newton's work in mechanics for the Enlightenment thinkers who struggled to apply physical laws to the social realm.

The work of Emilie du Chatelet can be related to each of the activities in this module, but most clearly to Activity III, "Probability Applied." She worked wth the mathematics of how variables are related. Your students in Activity III will work with how one variable, "chance that any one calculator is defective," and how it is related to (is a function of) a second variable, "proportion of defective calculators in a sample of all the calculators."